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THE NEW YEAR

Astronomical Science has contributed directly to the welfare of humanity in many practical ways. It has, for example, made navigation possible, and has furnished a basis for accurate land surveys on a large scale. Also indirectly it has influenced the course of progress, sometimes in unsuspected places. At this moment we are thinking of the impetus for improvement which every enterprise receives at the beginning of a new era in its career. There is no other occasion so universally useful in marking a period for renewed and intentionally improved efforts as the beginning of a new year. Here then is an example of the indirect influence of astronomy since the time interval of one year is determined by the astronomical observation that the earth completes a revolution around the sun in that interval.

It is highly appropriate, therefore, that at the beginning of the new year those who are responsible for such an enterprise as the publishing of an astronomical magazine should look backward and forward. Looking backward we see, as is usually true, that some things might have been done differently and better. In spite of this, however, many have from time to time expressed their approval of our work and thereby have given more encouragement than they realized. Looking forward we venture to promise for the coming year that POPULAR ASTRONOMY will fill its place as well as, and we hope much better than, it did in the year that is past.

Of our contributors we beg indulgence if their papers do not appear so promptly as they might wish them to. The delay is due not to a lack of appreciation of the manuscripts but to the limitations of space. Of our readers we respectfully solicit criticism and suggestions. The criticism will be heeded and the suggestions adopted if deemed practicable; and in any case they will be greatly appreciated.

To both readers and contributors we extend most cordial good wishes for the New Year.

AN AMATEUR'S OBSERVATORY.

By WILLIAM TYLER OLCOTT.

"O, watchers of the stars at night,
Who breathe their fires, as we the air."

There are doubtless many who are engaged in telescopic work who have not as yet built an observatory, and there may be others who have never taken up telescopic work who might be interested to know something about such a building, and what it has to offer its possessor in the way of enjoyment and convenience.

For those contemplating the construction of an observatory, it is certainly of interest to learn what has been done by others in this line, that they may profit by another's experience, and avoid his mistakes.

The Editor of POPULAR ASTRONOMY has therefore opened the pages of his Journal to the publication of articles on private observatories, and it is a pleasure to describe briefly my observatory and modest equipment.

It is true that a sheltered spot in the open air is the best possible observing place, but the difficulty of finding a location out of reach of the wind, and out of range of artificial lights, particularly if the observer lives in a city, is a consideration that the amateur has to contend with. Then, too, if he would take advantage of the fine nights for observing that winter affords, he is subjected to a temperature that is often sufficiently low to dampen his ardor and render his efforts difficult and uncomfortable.

An observatory, if properly constructed, is certain to afford the possessor pleasure that will amply repay him for its cost of construction.

The advantages of an observatory over an observing platform in the open are quite obvious. First, you are protected from the wind and artificial lights, also from extreme cold. You have a dry and convenient place to work in, and for keeping eyepieces, charts, and other material that you require. You have also an attractive place in which to entertain visitors.

There are all sorts of designs for observatories, that vary considerably in cost. It is a case of putting up the best structure you can afford, for it is your work room and will ever be a source of pride and satisfaction to you.

As this article concerns my observatory it is not incumbent on me to describe the different types of observatories suitable for the amateur. I am living in an old New England hip-roofed house, built in 1768, the home of my ancestors. It is situated in the centre of the town with a little garden space in the rear of the house.

My first thought was to erect the observatory in the garden, but this meant going out of doors. As it was feasible to put the structure on

top of the house without detracting from its appearance, I decided to cut through the hip roof and erect it there, with stairs leading up to it from the attic.

The weight of the structure and mounting is considerable, but by supporting the structure on the plates of the house, and thus distributing the weight, the danger of settling was obviated. It is desirable in most cases, to erect a concrete pier set well in the ground to support the mounting, thus eliminating vibration. In my case it was quite out of the question to carry a pier to the top of the house.

FIGURE 1.
DOME OF OBSERVATORY AT THE REAR BETWEEN THE CHIMNEYS.

I had no set of plans or specifications, and the local carpenters knew nothing regarding such construction as I required, but, with the aid of a pasteboard model (constructed to scale), they succeeded in carrying out my plans admirably. If I had the work to do all over again, there are only a few minor changes that I would make, so well does the observatory answer my purpose.

The building is of wood, octagonal in shape, surmounted by a dome in the shape of a truncated pyramid. The eight side sections were constructed at the shop, and assembled on the roof. There is a window in each section, and thus I command a view in all directions, which is a great advantage. The observatory is ten feet in diameter, but it should properly be twelve or fifteen feet, as I am a little cramped for room when I have many visitors. There are three light shutters in the dome, operating separately, and vertically, in grooves. They are held in position by pulleys, and when the ropes are released the shutters descend

rapidly to their proper position.

The dome revolves on a wooden track on twenty-six ball-bearing roller skate wheels. I can easily move the dome with one hand, but it is by no means as easily moved as many domes I have seen. If I had the work to do over again, I would use only three or four large wheels on an iron track to avoid unnecessary friction, although this is a noisier arrangement than the wooden track. The dome is of wood covered with painted canvas. It is water tight, but requires a coat of paint every year or so.

FIGURE 2.
THE OBSERVATORY ON THE ROOF.

The telescope is a 5-inch Lohmann refractor, equatorially mounted. The circles are illuminated with tiny incandescent bulbs, red in color to obviate glare. Red lights are also used to illuminate the observatory.

The telescope is mounted on a 6-inch iron pipe. A flange at its base is screwed into a steel I-beam ten feet long, which is supported at the ends by two trestles made of quartered oak bolted and tennoned, and absolutely rigid. The floor of the observatory, which is three feet above the I-beam, comes up to, but does not touch the pillar. Vibration is thus practically eliminated except when a heavy truck passes the house.

The feature of the mounting is the vertical movement of the pillar, which has all the advantages of a rising floor, and no disadvantages as far as I can see. I accomplished this by sinking an inner pipe, like a plunger, milled to engage closely the 6-inch pillar. The mounting rests on the top of the inner pipe, and a crank and chain gear permits of a vertical movement of three feet which is a great advantage, as it allows

the observer to assume a comfortable observing position regardless of the position of the object to be observed. This does away with the cumbersome ladder that is such a nuisance in a great many small observatories. It was thought at first that I could not carry out this idea suc-

FIGURE 3.
INTERIOR OF OBSERVATORY SHOWING APPARATUS FOR VERTICAL MOTION.

cessfully, as any lost motion or back-lash in the gear would be apt to cause a shift in azimuth to the mounting, which would be fatal to accurate adjustment. By cutting a half-inch groove in the side of the inner pipe, and bolting a wedge to engage it closely, on the top of the 6-inch

pillar, the mounting rides evenly in the groove and the wedge prevents any movement whatever in azimuth.

The print of the interior shows clearly the crank and chain gear for raising the mounting vertically, and the inner pipe sunk in the outer. The wedge that runs in the groove in the inner pipe is bolted to the projecting rim of the pillar. This is an expensive refinement but well worth its cost. I find it especially convenient when I have visitors, as I can quickly accommodate the position of the telescope to the height of the observer; then, too, I do not have to use a diagonal eyepiece for stars located near the zenith.

The dome is turned by a lever, seen at the right in the print of the interior of the observatory. The pulley ropes for the shutters are attached to the lever which is fixed exactly opposite the slit in the dome. This enables the observer to turn the dome the short distance often required without moving from his observing position. In a dark observatory it is a great advantage to have the lever in this position.

There are two deep recessed drawers seen in the print of the interior, back of the pillar. In these I keep eyepieces and charts. The interior of the dome is painted black and the walls are adorned with celestial photographs of interest.

The observatory was an expensive piece of work but has already amply repaid me in pleasure for the money spent. In two minutes time I can turn the dome, open the shutters, and be ready to observe. It is always advisable, however, to leave the shutters open for half an hour, or more, before observing, to allow the heat to escape from the interior of the observatory to facilitate good seeing. As the observatory was built without plans or specifications I am unable to give exact dimensions, but I will be glad to answer any questions regarding the structure, and particularly regarding the mounting which I believe is quite unusual. Its convenience and flexibility should commend it to those who contemplate mounting a telescope.

The observatory was finished in September, 1921. It was dedicated at a meeting of the American Association of Variable Star Observers held at my home June 3, 1922, and christened "Starlight House."

Since 1910 I have been engaged in the observation of long-period variable stars, the most practical work that the amateur can engage in. Every observation is published and has positive scientific value.

The amateur should join the American Association of Variable Star Observers, and coöperate in the interesting and valuable work the organization is engaged in. As Secretary of the Association I will be glad to furnish all those who are interested with further information. Charts and instructions are furnished all our members gratis.

In closing, I extend a cordial invitation to any persons interested, who happen to be in this vicinity, to inspect my observatory.

Norwich, Connecticut.

THE PHOTOHELIOGRAPH OF THE U. S. NAVAL OBSERVATORY AND NOTES ON THE RECENT SUN-SPOT MAXIMUM.*

By GEORGE HENRY PETERS and NICHOLAS EMORY WAGMAN.

The sun has been observed with the photoheliograph at the Naval Observatory for the past thirty years. A detailed description of this instrument and the methods of observation will be found in Vol. XII, Second Series, of the Observatory Publications.

The optical parts of the photoheliograph consist of a 5-inch Clark lens of about 40 feet focus, corrected for the actinic rays. The axis of this lens is horizontal, and in the meridian, with the objective to the north. Solar rays are projected through this objective by an optically plane 7-inch mirror. This mirror is unsilvered and wedge-shaped so that reflections from the rear surface are deviated by about 2 degrees. Consequently they do not interfere with the primary image.

The objective and mirror are mounted on a substantial brick pier. The mirror is mounted on a tripod to the north of the objective. Slow motions on the equatorial type of mounting, or coelostat, carrying the mirror, facilitate setting the solar image accurately on the *target*. The target is a painted disk on the front of the focal plane shutter. When the solar image is set upon this target, it will fall symmetrically on the 7x7 inch plate at the focus of the instrument when the exposure is made. These plates, of course, are not a commercial size. They are coated to order with a slow lantern slide emulsion on thin selected glass. Before exposing, they are "backed" with a thin paste of moist lamp black to prevent halation. This backing is removed with a tuft of moist absorbent cotton before developing the plate.

Close in front of this photographic plate hangs a fine plumb line, indicating the vertical by the shadow impressed on the solar image during the exposure. The slit width of the shutter is controlled by a fine micrometer screw for varying the exposure time. The shutter falls vertically by gravity and is released by the observer near the objective of the instrument. As the exposure of each section of the solar image by this focal plane shutter is estimated to be about .05 of a second, no clock work is required to operate the coelostat.

The photographic plate is carried in a metal frame with collimating attachments in azimuth, and is adjustable by a micrometer screw for focus. This part of the apparatus is mounted on an iron pier, which is independent of the floor of the building. The focusing attachment is required on account of changes in focal length of the optical parts by temperature variations, either daily or at different seasons. These

*Communicated by Captain C. S. Freeman, U. S. Navy, Superintendent.

thermal changes, as a whole, involve differences of about ½ inch, (12 mm), between summer and winter. The focal length is shortest at low temperatures.

The dark room, in which the plates are developed, also serves as a camera into which the solar image produced by the 40-foot objective is

FIGURE 1.

DARKROOM, PLATEHOLDER, AND SHUTTER OF THE PHOTOHELIOGRAPH.

received through the northern wall, where the shutter is mounted. From the building, and extending nearly to the objective, a peaked roof shed acts as an open tube, cutting off the sky light and general outside illumination. Beneath the shed, wire screens afford ventilation and prevent the uprush of air currents, materially improving definition.

The general character of the photoheliograph and its surroundings, as viewed from outside the building looking west, is shown in the accompanying illustration. The solar images on the negatives obtained with

this instrument are about 4¼ inches in diameter. When atmospheric seeing conditions are good, excellent definition is obtained.

The solar negatives are measured by means of glass transparency plates. Upon these plates the solar coördinates are shown as black lines. The coördinates correspond to the epoch of observation, within a circle representing the diameter of the solar disk at that period. Twenty-two of these transparencies are available, allowing for apparent variations of the solar diameter and also for the changes in latitude of the sun's center, as given in the *American Ephemeris*. The original drawings from which they were reproduced were made by Mr. Watts and Miss Lamson. Areas of spots and groups are measured in square degrees by an auxiliary glass reticule, or transparency, which allows for foreshortening of the image as the solar limb is approached. For publication, these areas are transformed into millionths of the sun's visible hemisphere by the use of tables.

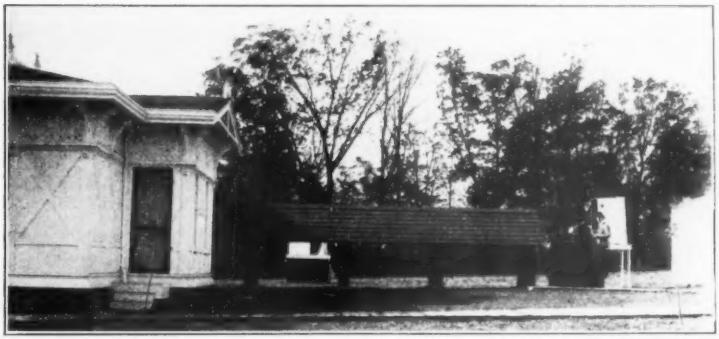

FIGURE 2.
PHOTOHELIOGRAPH FROM OUTSIDE.

To derive these solar data the hour angle of the plumb line's shadow image, before mentioned, at the time of observation is used as a base of reference on the measuring machine. The computed angle of the plumb line is set off on the position circle of the instrument with reference to the central solar meridian as shown on the coördinate transparency. After centering the solar image with respect to the outer circle of the transparency, the latitudes and heliographic longitudes of objects may be read directly from the coördinates. These coördinates are indicated by lines at intervals of ten degrees. A magnifying lens, which is part of the machine, is used in these measures.

Positions reliable to within half a degree are observable except near the sun's limb. This is about the same order of accuracy as that with which the center of gravity of irregular spots, or especially groups, can be estimated on the 4¼-inch solar image.

Since January, 1927, the Naval Observatory has published these solar data in the *Monthly Weather Review* of the U. S. Department of Agri-

culture. Observations on days missed at the Naval Observatory on account of clouds have generally been supplied through the coöperation of the Harvard Astronomical Laboratory, the Yerkes or the Mount Wilson observatories. In the *Monthly Weather Review* these solar data are published in the following form:

"Date," "Eastern Standard Civil Time," "Difference of Longitude" (i.e. from central meridian), "Longitude," and "Latitude." Areas are given under the captions "Spots" or "Groups"; also the total combined area for each day, and the mean daily area for the month. The *Review* is a government monthly publication issued under the auspices of the U. S. Weather Bureau, and is easily available. It will be found in many libraries or can be purchased at a yearly rate, or by the single copy, through the Superintendent of Documents, Government Printing Office, Washington, D. C.

A large solar group appeared in May, 1921. This was first observed with the photoheliograph on May 9, and crossed the solar meridian on the 14th. The following note from the observing book describes conditions at the latter date:

"Note: This large group, the only spots on the sun, excited great interest and newspaper comment. The brilliant aurora of the night of the 14th was attributed to it. Many notices of aurorae were received through the Hydrographic Office, as seen from vessels at sea."

Magnetic disturbances on the lines of the Western Union Telegraph Company, both land and cable, at this period seriously interrupted traffic and damaged some of the apparatus. At this time a coöperative campaign was instituted between the Western Union and the Naval Observatory to investigate the subject of these phenomena. The observatory undertook to furnish solar data to the Telegraph Company by wire or postcard on the day of observation. The Company was to note disturbances to traffic on its lines and secure observations of aurorae at several of its northern offices. They were to furnish charts, or graphs, monthly incorporating their own observations and also the solar data from the Naval Observatory. This arrangement was satisfactory to both parties, and still continues.

From the series of observations with the photoheliograph the last sun-spot minimum of August, 1923, was deduced. A paper on this subject, illustrated with a graph of the curve, was given by Mr. Peters at the Dartmouth meeting of the American Astronomical Society in 1924. The sun-spot curve from that minimum to the end of June, 1929, has also been derived from similar observations by the writers. It was found from this latter discussion that the recent sun-spot maximum was unique in several particulars. These unusual features are shown in the graph accompanying this article, and are further exhibited in Table I.

The ordinates of the curve in the graph depend upon averages of the mean daily areas of the spots or groups taken monthly. They are expressed in *millionths* of the sun's visible hemisphere. This monthly fluctuation in activity is represented by the fine line on the graph. The

abscissae represent the time function by years, subdivided into months. The smoothed curve is derived by Wolf's method, using areas instead of relative numbers, the formula for which is given below. The Roman numerals represent monthly mean daily areas.

$1/12\ (I + II + III\ .\ .\ .\ + XII) = n_1 =$ epoch of July 1
$1/12\ (II + III + IV\ .\ .\ .\ + XII + I) = n_2 =$ epoch of August 1
$1/2\ (n_1 + n_2) = r =$ smoothed curve number for July 15

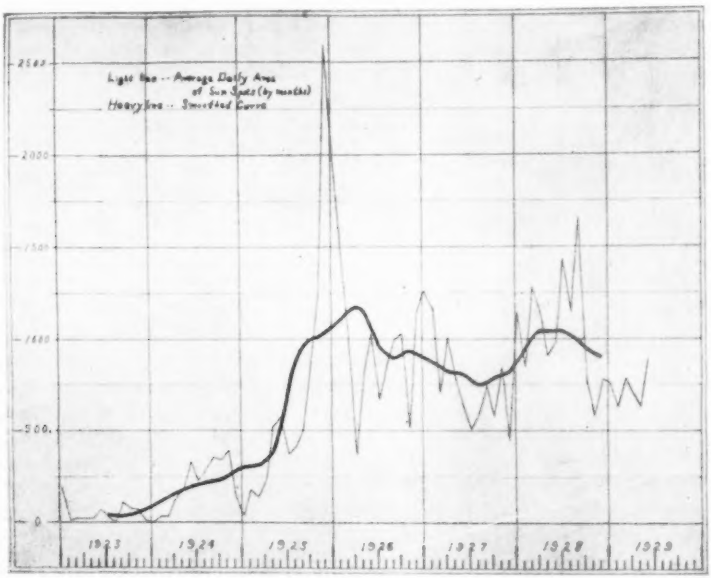

FIGURE 3.
GRAPH OF SUN-SPOT ACTIVITY, U. S. NAVAL OBSERVATORY.

TABLE I.

Year	Month	Mean Daily Area	Smoothed Area	Year	Month	Mean Daily Area	Smoothed Area
1923	Jan.	186	—	1924	April	131	154
	Feb.	6	—		May	178	178
	March	17	—		June	330	197
	April	18	—		July	232	204
	May	16	—		August	288	212
	June	71	—		Sept.	345	224
	July	30	44		Oct.	335	232
	August	2	37		Nov.	387	250
	Sept.	108	38		Dec.	153	274
	Oct.	79	44	1925	Jan.	38	290
	Nov.	74	55		Feb.	182	302
	Dec.	10	73		March	138	314
1924	Jan.	0	92		April	228	343
	Feb.	28	112		May	519	402
	March	32	134		June	569	538

TABLE I—CONTINUED.

Year	Month	Mean Daily Area	Smoothed Area	Year	Month	Mean Daily Area	Smoothed Area
1925	July	373	721	1927	July	527	754
	August	422	856		August	585	739
	Sept.	498	947		Sept.	741	756
	Oct.	879	990		Oct.	580	788
	Nov.	1250	1008		Nov.	846	800
	Dec.	2588	1040		Dec.	450	822
1926	Jan.	1980	1072	1928	Jan.	1138	874
	Feb.	1460	1097		Feb.	851	934
	March	1051	1136		March	1284	996
1926	April	368	1167		April	1137	1043
	May	818	1142		May	912	1040
	June	1025	1052		June	979	1043
	July	665	964		July	1434	1041
	August	855	918		August	1147	1016
	Sept.	991	885		Sept.	1662	986
	Oct.	1029	894		Oct.	773	946
	Nov.	518	918		Nov.	584	916
	Dec.	1152	898		Dec.	784	900
1927	Jan.	1274	876	1929	Jan.	756	—
	Feb.	1068	860		Feb.	634	—
	March	670	838		March	776	—
	April	980	809		April	698	—
	May	751	804		May	626	—
	June	635	788		June	889	—

TABLE II.

Year	Wolf No.	Area
1923	5.8	51
1924	16.7	203
1925	44.3	640
1926	63.9	993
1927	69.0	759
1928	77.8	1057

Table II gives a comparison between annual averages of daily areas, as computed at the Naval Observatory, and Wolf's sun-spot numbers for the period under discussion. No account is taken of the number of spots or groups, or of the instrumental function, in the graph or in Table I, as in Wolf's equations of relative numbers. Areas alone are here involved, although they are combined by Wolf's method. This criterion produces slight differences in this curve compared with that derived from Wolf's sun-spot numbers.

Some of the more interesting features of the present maximum are summarized below.

The period of time covered by the recent sun-spot activity was unusually long. Compared with previous normal maxima, the combined mean areas of spots or groups was moderate, during this active phase. The most notable feature, as shown on the graph, was the two peaks of greater activity separated by a period of about two years.

The previous minimum was in August, 1923. Based upon the typical sun-spot cycle of 11.1 years, a normal maximum should have occurred in 1927 or 1928. Considering this fact it is evident from an inspection of the graph that a double maximum has taken place. In each of these

maxima the summit of the curve attains approximately the same elevation. Wolf's sun-spot numbers, derived as stated by a slightly different method, show these two peaks occupying similar positions, but with the relative magnitudes interchanged.

It is likely that the solar activity as denoted by sun-spots is now diminishing. At the end of June, however, when the data available were concluded, many spots and groups, some of large size, were still in evidence. At present many of these objects, after forming, change rapidly or disappear entirely within a few days. This fact is usually considered a sign of decadence in spot production. Soon a considerable decline in activity should be expected.

WASHINGTON, D. C., AUGUST 16, 1929.

THE GROOTFONTEIN METEOR.

By WILLEM J. LUYTEN.

Toward the middle of February the editor of *Die Volksblad*, the Afrikaans daily newspaper of Bloemfontein, showed me a photograph he had received from one of his readers, which photograph purported to be of an enormous meteor lying in the Grootfontein district, South West Africa. A hurried inquiry as to the reality of this meteor, made by writing to the directors of the various museums in the Union and to several newspaper editors, disclosed the fact that although the existence of this enormous meteor had been known for a considerable length of time little more was known. From Johannesburg came the wild report that a small sample had given a nickel percentage as high as

FIGURE 1.
THE VELD AT GROOTFONTEIN WHERE THE METEOR CAME TO EARTH.

33. It was thought worth while, therefore, to investigate the meteor, and in the beginning of March I left for South West.

The journey from Bloemfontein to Grootfontein, some 1550 miles, was uneventful, though tiresome. Owing to the narrow gauge of the railway (four feet, six inches, which the government here is pleased to call standard gauge) traveling is slow; an unexpected rain in the desert country around Keetmanshoop washed away part of the railway line, thus making the journey even slower. A stop-over at Windhoek, advisable in order to obtain the necessary information and permits from the administration, was more than welcome.

The administration (mandate of the Union of South Africa, since the War) was courtesy itself, and extended all possible privileges as well as giving full information acquired up to that time. On one point,

FIGURE 2.
THE GROOTFONTEIN METEOR SEEN FROM ABOVE.

however, they were quite clear and firm: that it would be utterly hopeless to try and remove the meteorite from South West; even in the German time the removal of meteors from the country was forbidden and the present mandate government intended to abide by the same decision.

Grootfontein was reached after a 260-mile trip on a real narrow gauge railway (two feet only) built as a private railway by the Otavi Mine Company. To our great surprise they were still able to run a dining car with excellent service on this toy train, although the kitchen couldn't have been much larger than a telephone booth. The next morning I was met by Mr. J. H. Oosthuizen, the present owner of the farm Hoba Wes, on which the meteor lies. He kindly drove me out to his farm, twelve miles due west of Grootfontein.

The first impression one gets of the meteor, seeing it from a distance,

is not too overwhelming, but this changes when one gets close to it. It is an enormous block of metal, almost rectangular in shape, of dimensions nine by ten feet (these are outside measures), and a thickness varying from two and a half to almost four feet. A remarkable feature of it is that it came down in such a way as to leave the upper surface, which is almost flat, horizontal as well. As it happened, the thicker side must have struck comparatively soft limestone while the thinner edge stopped short in harder rock. When first found, according to the majority of reports by the engineer, Toenisson, only a small part protruded above the limestone; since then a pit has been dug all around it which shows the full extent of the meteor on all sides. On the northeastern side this pit has been excavated to a depth of eight feet, and in

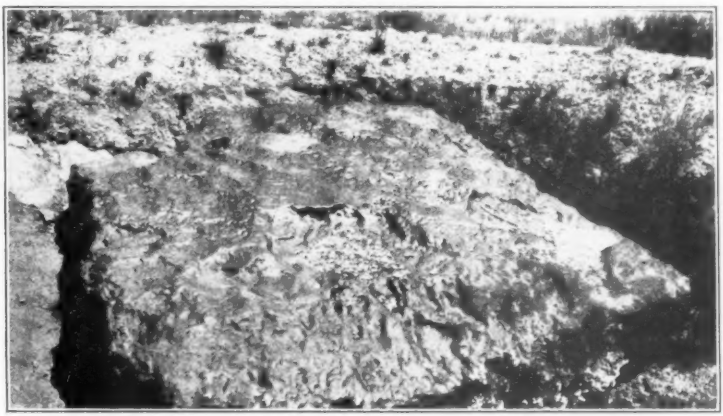

FIGURE 3.
THE GROOTFONTEIN METEOR, SHOWING WHERE THE OXY-ACETYLENE FLAME LEFT ITS MARKS.

this way the compression of the layers of limestone under the meteor can easily be seen, as well as the sharp upward bending of these layers on the sides. Owing to the position of the meteor it is not possible to ascertain how much of a "nose" it has, and how deep this nose has buried itself in the rock. Accordingly only a rough estimate can be made of its mass, in all probability not less than fifty tons.

It would thus appear to be the most massive meteorite known at present, leaving aside for the moment the gigantic Arizona meteor that has not yet been brought to light. The meteor of Bacubirito is given by some to weigh as much, but since it is not mentioned in Russell's textbook, one may surmise that there is, perhaps, a little uncertainty attached to it. The Greenland meteor brought back by Admirable Peary, and now reposing in The American Museum of Natural History in New York, weighs 36½ tons, considerably less than the Grootfontein specimen.

One remarkable feature of this meteor (at least it appears remarkable to the writer) is that it felt cool, in spite of the scorching of the tropical sun almost overhead, which made the surrounding limestone unpleasantly hot to touch. It is said that this meteor is not magnetic; the present writer had no occasion to verify this. The Otavi Minen und Eisen-

FIGURE 4.

THE PIT ON THE NORTHEASTERN SIDE OF THE METEOR SHOWING ITS DEPTH AND EXTENT.

bahn Gesellschaft kindly let me have the results of their chemical analysis, which shows 17.42 per cent nickel and 81.29 per cent iron. This is an unusually high proportion of nickel, though not so high as the original Johannesburg estimate. It is not surprising, therefore, that the meteor is extremely hard and especially tough. Investigation with a file, and comparison with various kinds of commercial steel, led to the estimate that this nickel-iron alloy compares in hardness with the hardest steel used on the railroads,—that used in locomotive wheels. An idea of the toughness may be obtained from the fact that it took fully two

hours of sawing and more than a dozen hacksaw blades to saw off a piece with a surface of only two square inches.

The Grootfontein meteor, though unique because of its great bulk, is not the only meteorite in South West Africa. Farther south, in the desert limestone just east of Gibeon, is a whole valley that is simply peppered with small meteors. Some forty or fifty of these have been dug up, and, except for those sent to museums in Germany, they are preserved in Windhoek, where they have been made into a rockery in the public park. They are all of about the same size, weighing in the neighborhood of 500 pounds, and all contain between seven and eight per cent of nickel. Since their existence has been well known for a long time it is not necessary to dwell upon it here.

TSUMEB, SOUTH WEST AFRICA, MARCH 15, 1929.

LIST OF STARS NEARER THAN FIVE PARSECS.

By P. van de Kamp.

In 1922 Hertzsprung published a list of 29 stars [including our Sun] which then were found to be nearer than five parsecs [*B.A.N.*, I, 21]. Increased knowledge of the parallaxes of these and additional stars led to the construction of the present list, which contains information about 36 stars, for which the measured parallax is larger than 0″.2. As a rule, only modern photographic trigonometric determinations have been used in this list. The published relative parallaxes have been made absolute by adding the parallax of the comparison stars used in the determinations.

Following the list of 36 stars are given 8 additional stars [a . . . h], which eventually might prove to have a parallax larger than 0″.2.

The order of the stars in the present list is one of decreasing parallax. It is evident that future measures may change the order of the stars, particularly of those at the bottom of the list.

It goes without saying that not all of the parallaxes of the list are of equal accuracy; many values are based on only one determination [occasionally by the heliometer or by the spectroscopic method], the largest number of determinations being eight for Barnard's star. [This star has its parallax known with the greatest relative accuracy, namely $p = +0''.542 \pm ''.004$, the percentage probable error being 0.8%.] In the present table, however, any indication as to the accuracy of the individual parallaxes has been omitted. For most general purposes it will suffice to assume a probable error of about ±″.010 for the parallax values of this list.

The probable error r_d of the distance d expressed in light-years, and the probable error r_p of the parallax p, are connected by the formula:

$$r_d = \frac{d^2}{3.26} r_p$$

Thus with the same accuracy in the parallax value the error of the distance [in light-years or any other unit] increases with the square of the distance; the percentage error of this distance increases directly proportional to the distance.

In the present case, the probable error of the distance in light-years [1 parsec = 3.26 light-years] increases from about 0.05 at the top of the list to about 1.0 at the bottom.

The next to last column contains the absolute visual magnitude, M, computed by the formula:

$$M = m + 5 + 5 \log p$$

where m is the apparent visual magnitude and p is the parallax.

The error in M is caused mainly by the error in m [with a parallax of 0".2 an error of 0".02 in the parallax gives an error in M of only $0^m.2$] and may be appreciable, especially for the apparently faint stars in the list, whose magnitudes are not always accurately known.

The last column contains the visual luminosity expressed in units of the visual luminosity of the Sun. This luminosity L and the absolute magnitude M are related by the formula:

$$\log L = 0.4\,[4.85 - M]$$

where 4.85 is the absolute visual magnitude of our Sun. In the case of the stars whose magnitudes are not accurately known, the luminosity becomes, of course, also uncertain; an error of 0.75 in M causes an error of 100% in L.

Restricting ourselves to the list of 36 stars, we find four stars, whose luminosity exceeds that of the Sun. In order of decreasing luminosity, these stars are:

No.	Name	Sp.	M	L
7	Sirius A	A0	+1.2	29.
35	α Aquilae	A5	+2.5	8.7
15	Procyon A	F5	+2.9	6.0
2	α Centauri A	G0	+4.7	1.15

There are eight stars whose luminosity is less than 0.001 times the Sun's luminosity. In order of increasing luminosity, these stars are:

No.	Name	Sp.	M	L
5	Wolf 359	dM4e	+16.5	0.000022
1	Proxima Centauri	M	+15.5	.000055
16	Procyon B	—	+15.4	.00006
10	Innes' Star	—	+14.7	.00011
29	van Maanen's Star	F0	+14.2	.00018
4	Barnard's Star	dM3	+13.4	.00038
25	Krüger 60 B	M4	+12.9	.00060
21	Groombr. 34 B	dM5	+12.8	.00066

Of these eight stars, the first three are at present the faintest stars known.

Nineteen stars of the 36 [53%] are dwarf M-stars [ranging in M

List of Stars nearer than Five Parsecs.

No.	Name	1900 R.A. h m	1900 Decl. ° ′	Vis. Mag.	Sp.	Annual Proper Motion ″	Parallax ″	Distance in Light-years	Abs. Vis. Mag.	Visual Luminosity ⊙ = 1
1	Proxima Centauri	14 22.9	−62 2	11	M	3.76	0.786	4.15	+15.5	0.000055
2	α Centauri A	14 32.8	−60 25	0.3	G0	3.68	.758	4.30	+ 4.7	1.15
3	α Centauri B	14 32.8	−60 25	1.7	K5	3.68	.758	4.30	+ 6.1	0.32
4	Barnard's Star	17 52.9	+ 4 28	9.7	dM3	10.30	.542	6.01	+13.4	0.00038
5	Wolf 359	10 51.6	+ 7 36	13.5	dM4e	4.84	.407	8.0	+16.5	0.000022
6	Lalande 21185	10 57.9	+36 38	7.6	dM2	4.77	.403	8.1	+10.6	0.0050
7	Sirius A	6 40.7	−16 35	−1.6	A0	1.32	.363	9.0	+ 1.2	29.
8	Sirius B	6 40.7	−16 35	8.4	A7	1.32	.363	9.0	+11.2	0.0029
9	B.D. −12° 4523	16 24.4	−12 24	9.5	dM5	1.24	.351	9.3	+12.2	0.0011
10	Innes' Star	11 12.0	−57 2	12	—	2.69	.340	9.6	+14.7	0.00011
11	B.D. −7° 4003	15 14.3	− 7 21	9.2	dM5	1.33	.331	9.8	+11.8	0.0017
12	Kapteyn's Star	5 7.7	−44 59	9.2	K2	8.70	.320	10.2	+11.7	0.0018
13	τ Ceti	1 39.4	−16 28	3.6	K0	1.92	.319	10.2	+ 6.1	0.32
14	ε Eridi.	3 28.2	− 9 48	3.8	K0	0.97	.305	10.7	+ 6.2	0.29
15	Procyon A	7 34.1	+ 5 29	0.5	F5	1.24	.304	10.7	+ 2.9	6.0
16	Procyon B	7 34.1	+ 5 29	13	—	1.24	.304	10.7	+15.4	0.00006
17	61 Cygni A	21 2.4	+38 15	5.6	K7	5.21	.300	10.9	+ 8.0	0.055
18	61 Cygni B	21 2.4	+38 15	6.3	K8	5.21	.300	10.9	+ 8.7	0.029
19	ε Indi	21 55.7	−57 12	4.7	K5	4.67	.291	11.2	+ 7.0	0.14
20	Groomb. 34 A	0 12.5	+43 27	8.1	dM2	2.85	.290	11.2	+10.4	0.0060
21	Groomb. 34 B	0 12.5	+43 27	10.5	dM5	2.85	.290	11.2	+12.8	0.00066
22	Σ 2398 A	18 41.8	+59 29	8.8	dM4	2.28	.288	11.3	+11.1	0.0032
23	Σ 2398 B	18 41.8	+59 29	9.3	dM5	2.28	.288	11.3	+11.6	0.0020
24	Krüger 60 A	22 24.5	+57 12	9.3	dM3	0.94	.264	12.3	+11.4	0.0024
25	Krüger 60 B	22 24.5	+57 12	10.8	M4	0.94	.264	12.3	+12.9	0.00060
26	Lalande 8760	21 11.4	−39 15	6.6	dM1	3.53	.253	12.9	+ 8.6	0.032
27	Groomb. 1618	10 5.3	+49 58	6.8	dM0	1.45	.250	13.0	+ 8.8	0.026
28	Lacaille 9352	22 59.4	−36 26	7.4	dM2	6.90	.247	13.2	+ 9.3	0.017
29	van Maanen's Star	0 43.9	+ 4 55	12.3	F0	3.01	.246	13.3	+14.2	0.00018
30	A Oe 17415-6	17 37.0	+68 26	9.1	dM4	1.31	.222	14.7	+10.8	0.0042
31	B.D. +43° 4305	22 42.5	+43 48	9.5	dM5e	0.86	.207	15.7	+11.1	0.0032
32	o^2 Eridi. A	4 10.7	− 7 49	4.5	G5	4.08	.205	15.9	+ 6.1	0.32
33	o^2 Eridi. B	4 10.7	− 7 49	8.9	A	4.08	.205	15.9	+10.5	0.0055
34	o^2 Eridi. C	4 10.7	− 7 49	10.8	dM6e	4.08	.205	15.9	+12.4	0.0010
35	α Aquilae	19 45.9	+ 8 36	0.9	A5	0.65	.204	16.0	+ 2.5	8.7
36	B.D. +20° 2465	10 14.2	+20 22	9.0	dM4e	0.49	.202	16.1	+10.5	0.0055

LIST OF STARS NEARER THAN FIVE PARSECS.

No.	Name	1900 R.A. h m	1900 Decl. ° ′	Vis. Mag.	Sp.	Annual Proper Motion ″
a	70 Ophiu. A	18 0.4	+ 2 31	4.3	K0	1.13
b	70 Ophiu. B	18 0.4	+ 2 31	6.0	K4	1.13
c	Lalande 25372	13 40.7	+15 26	8.5	dM2	2.30
d	Strb. 1611	5 26.4	— 3 42	8.8	dM3	2.22
e	279 Sagitr. A	20 4.6	—36 21	5.3	K5	1.62
f	279 Sagitr. B	20 4.6	—36 21	11.3	—	1.62
g	Cord. 32416	23 59.5	—37 51	8.5	dM3	6.11
h	Cord. A 15480	22 55.0	—23 4	7.6	dM1	0.90

No.	Name	Parallax ″	Distance in Light-years	Abs. Vis. Mag.	Visual Luminosity ⊙ = 1
a	70 Ophiu. A	0.196	16.7	+ 5.8	0.42
b	70 Ophiu. B	.196	16.7	+ 7.5	0.087
c	Lalande 25372	.195	16.7	+10.0	0.0087
d	Strb. 1611	.190	17.2	+10.2	0.0072
e	279 Sagitr. A	.190	17.2	+ 6.7	0.18
f	279 Sagitr. B	.190	17.2	+12.7	0.00072
g	Cord. 32416	.182	17.9	+ 9.8	0.010
h	Cord. A 15480	.174	18.7	+ 8.8	0.026

from +16.5 to +8.6, or in L from 0.000022 to 0.032]. Of the other six dwarf stars fainter than M = +10.0, two have no known spectrum [No. 10: Innes' star, and No. 16: Procyon B], one is a K2 star [No. 12: Kapteyn's star] and three are the so-called "white dwarfs":

No.	Name	Sp.	M	L
33	o^2 Erid. B	A	+10.5	0.0055
8	Sirius B	A7	+11.2	.0029
29	van Maanen's Star	F0	+14.2	.00018

Eighteen of the 36 stars [50%] are components of 6 double star and 2 triple star systems respectively.

The stars in the present list exhibit clearly the general relation between spectral type and absolute magnitude. With the exception of the three white dwarfs and a few late type dwarfs [Kapteyn's star, Proxima Centauri, and perhaps Wolf 359] all stars fall very close to the "central line" of the "main sequence" of stars. For a better knowledge of the true scattering a more accurate knowledge of apparent magnitudes and spectral types appears very desirable and much more urgent than is the case with the parallaxes, which for these nearby stars are relatively well known.

LEANDER MCCORMICK OBSERVATORY, UNIVERSITY OF VIRGINIA,
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AMERICAN ASTRONOMICAL SOCIETY.

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Des.	R.A.(1900) h m s	Dec.(1900) ° ′	Period d	Max.	Min.
5	18 40 50	—4 43.3	0.459745	12.9	14.5
6	18 41 04	—5 15.3	0.130761	12.7	13.7
8	18 42 03	—4 52.1	3.8+	11.9	13.5
10	18 44 52	—4 29.1	4.5924±	13.2	14.7
12	18 45 50	—7 55.4	0.153207	11.4	12.0
			0.30645	11.4	12.0
28	19 05 01	—0 31.4	69.50	13.0	14.6

No. 28 appears to be an RV Tauri variable.

The region investigated is one of 210 square degrees, extending from $18^h\ 16^m$ to $19^h\ 10^m$ in R.A., +1 to —14° in declination. It includes nine of the Harvard Milky Way regions. The photographs used were made with the 7½-inch and the 10-inch Cooke triplet lenses of the Maria Mitchell and the Harvard observatories, respectively. Plates made with other Harvard telescopes were used whenever necessary.

Periods have been found for twenty-seven variables of long period, and for nearly all of Miss Walton's new variables, with the exception of Numbers 3, 4, 16, 19, 21, 24, 26, which have been rejected because they do not vary more than four-tenths of a magnitude. Although new variables may be found whenever the plates are examined for them, the aim is first to find periods for the many known variables in the region. The results to date will be published soon in a *Harvard Bulletin*.

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In the accurate reception of wireless time signals two methods are in general employed, namely, the vernier method of coincidence by ex-

tinction of signals heard through telephone receivers, and the method of automatic recording of the received signal together with a local clock. The paper shows that the ear method can be applied to weak signals in the presence of static, giving nearly normal accuracy even under conditions that render automatic recording impossible. With ordinary signals the two methods are about equally reliable, provided the utmost care is taken with the recording system to eliminate delay of response as well as variable lag as between the incoming signal and the local clock. The obvious advantage of the recording method is in the automatic and permanent nature of the record. The results are deduced from 10 years experiment and investigation at the Dominion Observatory.

AN ACCESSORY DEVICE FOR SIMPLIFYING MEASURES WITH THE HARTMANN SPECTRO-COMPARATOR.

By F. Henroteau.

This device consists of an additional fine screw by which the plate carrier with the plate to be measured can be moved. The measurement of the plate becomes then greatly simplified because the coincidence of comparison lines of the two plates is effected by this screw, while the coincidence of the stellar lines is brought about by the micrometer screw attached to the lower plate carrier. Starting this micrometer screw at division zero, the sum of the micrometer readings for the various sections into which the plate is divided can then be read at the end of the measurement. If there are, for instance, twenty sections, only one reading of the drum is made instead of forty, beginning and end of each section. The work of twenty subtractions and one addition also disappears automatically.

ARE ALL CEPHEIDS LONG-PERIOD BINARIES?

By F. Henroteau.

Radial velocity curves of δ Cephei, η Aquilae, and ζ Geminorum were shown. The probability of the existence of variations in the shape of the curves and in the center-of-mass velocity was pointed out. The results will appear in detail in the *Dominion Observatory Publications*.

SEISMOLOGY IN CANADA.

By E. A. Hodgson.

The author first traces the history of seismological investigation in Canada as (1) the work of the early investigators—Sir Wm. Dawson, Dr. Smallwood, and Messrs. McLeod and Callendar, and (2) the systematic recording beginning at Toronto in 1897, Victoria in 1898, Ottawa in 1906, Saint Boniface (Winnipeg) in 1911 (to 1914 only), Halifax in 1915, Saskatoon in 1915, Sainte Anne de la Pocatiere in 1925

(to 1927 only), Shawinigan Falls in 1927, and Seven Falls (Beaupré) in 1927. The type of instruments installed, the nature of the records obtained, their evaluation and publication are next described. The paper concludes with a brief outline of the present programs of seismological research in operation in Canada.

A DETERMINATION OF MAGNITUDES, SPECTRAL TYPES, AND COLOR INDICES IN THE SCUTUM CLOUD, WITH A STATISTICAL DISCUSSION.

By C. J. Krieger.

A detailed study of the characteristics of the Scutum Cloud includes 2000 stars between 5th and 18th magnitude.

The photographic magnitudes are obtained by making successive exposures of the field and the standard stars of the North Polar Sequence on the same plate. While the spectral types of the brighter stars up to about 13th magnitude can be found directly from slitless spectrograms, those of the fainter stars are determined by means of color indices secured with a combination filter, consisting of one-half of a yellow, and one-half of a violet filter, side by side. The half-filter is turned through 180° for a second exposure.

From the color-magnitude diagram, that magnitude at which the maximum number of stars of a given spectral class is reached is found. From the relation between apparent and absolute magnitude and the parallax, the distance of the center of the Cloud is found as 2800 parsecs. The diameter is approximately 350 parsecs.

The frequency curves have the form of a normal error function with $\sigma = \pm 0.5$ to 1.0, indicating that the depth of the Cloud cannot be very great in comparison with its distance.

The density curves of all spectral classes indicate a pronounced separation of the Scutum Cloud from the Local System near 1500 parsecs. The depth of the Cloud appears to be from 500 to 1000 parsecs, with an average star density of about one-half of that in the neighborhood of the sun. A larger proportion of dwarfs, and a smaller proportion of giants, as compared with the Local System, are indicated.

If the Local System corresponds to the central condensation in a spiral nebulae, the Scutum Cloud would correspond to one of the smaller condensations in the spiral arms.

THE MAXIMUM DURATION OF A TOTAL SOLAR ECLIPSE.

By Isabel M. Lewis.

There is a lack of agreement in various astronomical text-books as to the maximum duration of a total solar eclipse. Many follow Du Sejour (*Histoire D. L'Acad. Roy. D. Sciences,* **1777**, 318-319) in giving $7^m\ 58^s$. Some, however, adopt Newcomb's value of $7^m\ 30^s$, given in his article on eclipses in the *Encyclopaedia Britannica* and elsewhere, while others give an intermediate value of $7^m\ 40^s$.

An attempt was made to find out which of these values is the correct one.

Neither Du Sejour nor Newcomb gave any details of the computations by which his results were obtained, but a computation made with the data, constants, and formulae used by Du Sejour yielded a value of $7^m\,58^s.8$. A repetition of the computation with modern data and constants gave a value of $7^m\,30^s.3$.

A study was next made of the conditions for maximum duration discussed by Newcomb in Vol. I *Astron. Papers Amer. Eph.* As pointed out therein it is impossible for all conditions to be fulfilled simultaneously. Calculations were made to test out various combinations of circumstances with a view to obtaining the maximum duration. It appears that the most favorable combination of circumstances possible, at least for some centuries to come, will occur early in the month of July; when the sun is at or near apogee; when the moon is at perigee and at its ascending node and its latitude 24 minutes South; and when the observer is on the equator. A computation for such a combination gave a value of $7^m\,31^s.1$ with the formulae and constants employed in calculating the duration of total eclipse given in the *American Ephemeris*. A check by means of Oppolzer's formula (*Canon Der Finsternisse*) gave a value of $7^m\,31^s.0$. This appears then to be the greatest possible duration for a total solar eclipse. Newcomb states that the maximum duration is *about* $7^m\,30^s$. It is of course impossible to predict the year in which such a hypothetical combination of circumstances would occur without recourse to lunar and solar tables extended ahead for centuries, though it is possible to say that if it should occur within the next five hundred years or so it must be in the month of July, as the sun will be in apogee early in that month for several hundred years to come.

The value of $7^m\,40^s$ given in several text-books was obtained by using Hansen's value of k (ratio of moon's semi-diameter to that of the earth). This is not the value of k now adopted in the calculation of eclipses.

Du Sejour's value for the duration is wrong because he used erroneous values for the semi-diameters and parallaxes of sun and moon and their hourly motions, as well as a value for the compression of the earth that was greatly in error.

A NEW METHOD OF DETERMINING TIME.

By F. B. Littell and J. E. Willis.

This method utilizes observations made with the photographic reflex zenith tube devised by Dr. F. E. Ross for the determination of the variation of latitude. Two methods of determining time have been used experimentally at the U. S. Naval Observatory.

The first method employs a specially designed plate-holder which is stationary during the observation, but which permits a small movement of the plate, carried on a slide inside the plate-holder, normal to the di-

rection of the trail produced by the star which is being observed. This movement is actuated electrically by the beats of the clock, and serves to produce a broken trail on the plate, each break representing a known beat of the clock, and forming a chronographic record of the star's transit. By reversing the rotary of the instrument, carrying the plate-holder 180°, just before the time of meridian passage of the star, the data on the plate are sufficient to determine the transit time of the star. Unfortunately, very few stars within the field of the instrument, which is only 20 minutes of arc in width, are bright enough to make a satisfactory trail. This method might be practicable for a similar instrument of larger aperture.

The second method utilizes the star images secured in the regular use of the instrument for variation of latitude work, in which the plate-holder is carried along by clockwork at the rate at which the star is moving, and so arranged as to give exposures of 15 seconds for each star image. This enables data to be secured from fainter and more numerous stars than is possible with the use of the first method. Signals are recorded automatically on a chronograph at certain positions of the plate-holder and, in connection with measures of the positions of the images on the plates, furnish the data for the determination of the time of transit of the star.

Preliminary experiments indicate that the second method will give good results for time determinations. The advantages which may be expected from the method as compared with the usual method depending on visual observations made with transit instruments are (1), the application of photography, (2), the comparatively great stability of the zenith tube which weighs about a ton, (3), the greater focal length, 203 inches, (4), the elimination of personal equation effects, (5), the elimination of the effects of instrumental errors, and of their variations.

VELOCITY STUDIES OF b^2 28 CYGNI.

By Hazel M. Losh.

The periodic motions of b^2 28 Cygni are based upon the radial velocities determined from the relatively narrow "central reversals" at the $H\beta$ and $H\gamma$ lines of hydrogen on one hundred and ninety-eight single-prism spectrograms made at the Detroit Observatory in the interval from 1911-1928.

A long period of several years, or a progressive change from a velocity of recession to one of approach, is evident. This change in the velocity of the star may synchronize with the variation in the emission lines.

A period of 226.0 days with secondary oscillations of 45.33 and 1.51775 days superimposed was determined. The velocity-curve of 226.0 days shows an irregularity after maximum of the type that is found in Phi Persei. With this type of an observational curve, it did not seem advisable to correct the elements by the method of least

squares:

$$
\begin{aligned}
P &= 226.0 \text{ days} \\
\mu &= 1^\circ.5929 \\
T &= \text{J. D. } 2{,}422{,}379.5 \\
e &= 0.746 \\
\omega &= 258^\circ.39 \\
K &= 12.20 \text{ km.} \\
\gamma &= -13.60 \text{ km.} \\
a \sin i &= 25{,}249{,}000 \text{ km.} \\
m_1^3 \sin^3 i/(m+m_1)^2 &= 0.013 \odot
\end{aligned}
$$

The following sets of elements corrected by the method of least squares for the shorter periods are:

P =	45.33 days	P =	1.51775 days
μ =	7°.9418	μ =	237°.1932
T =	J.D. 2,422.221.16	T =	J.D. 2,419,220.5294
e =	0.891	e =	0.2561
ω =	181°.14	ω =	255°.863
K =	19.00 km.	K =	4.89 km.
γ =	— 0.53 km.	γ =	+0.82 km.
$a \sin i$ =	5,377,000 km.	$a \sin i$ =	98.650 km.
$m_1^3 \sin^3 i/(m+m_1)^2$ =	$0.003 \odot$	$m_1^3 \sin^3 i/(m+m_1)^2$ =	$0.00002 \odot$

ARE THE GLOBULAR CLUSTERS AND THE ANAGALACTIC NEBULAE RELATED?

By Knut Lundmark.

Numerous measures of effective wave-lengths of anagalactic objects from plates taken at Mount Wilson and at Upsala have failed to reveal marked differences in mean spectral class or color index between the two main groups of galaxies—the spirals and the elliptical (or globular) objects. This, with other facts, suggests that the elliptical anagalactic objects are vast agglomerations or clusters of stars, rather than storehouses of amorphous nebulosity, in general neither so extensive, nor so massive, as the spirals.

On account of the large size of the anagalactic objects compared with their average mutual distance in space the conditions for an equipartition of energy seems to be pretty well fulfilled in the space containing the collection of galaxies, or the *metagalactic system*. On the assumption of equipartition it is found from the residual radial velocities of 25 elliptical objects and 17 spirals that the mean mass of the spiral galaxies is equal to, or larger than, 2.1 times the mean mass of the elliptical galaxies.

A study of double and multiple anagalactic objects gives a possibility of determining the mean total absolute magnitude of the elliptical galaxies. The data at hand give:

$$M = -13 \pm 1.5 \text{ (m. e.)}$$

Applying the mass-luminosity relation, it is found that the average mass of a spiral should be ten times as large as the average mass of an elliptical galaxy.

The large dispersion in the total absolute magnitude of the elliptical

galaxies shows that some of them match the Andromeda Nebula in luminosity, whereas others are not more luminous than the globular clusters.

Hubble's photometric work on the light distribution within elliptical nebulae and galactic globular clusters shows a general agreement in this respect between the two groups of objects.

The galactic globular clusters form a very homogeneous group in total absolute magnitude. The dispersion around the mean amounts only to $\pm 0^{M}.67$. It might well be possible that this low value is a result of unknown dynamical conditions, which may exercise an influence on the size and mass of the globular clusters, when they oscillate in the galactic strata. If the elliptical galaxies are nothing else than stellar clusters, they are, as a rule, less massive than the spiral galaxies. Sometimes they will form part of these and, if massive, dominate as central or secondary nuclei; other times they will be like satellites outside the principal system; again they will wander from galaxy to galaxy, as the comets have been thought of in the cosmogonies of Laplace and Schiaparelli.

Ordinary galactic globular clusters seem to exist in a number of spiral galaxies. What have been termed "nebulous stars" by Ritchey, in the spiral arms, are certainly, as pointed out earlier, in many cases, globular clusters; in others, open clusters; and in others again, ordinary luminous stars seen against a "nebulous" background. Since the globular clusters and the giant open clusters reach about the same absolute total magnitude, it will be difficult to distinguish the two categories. But they can be distinguished from ordinary stars in many cases and the determination of their apparent magnitude will give a new possibility of determining the distances of spirals, without making any assumption as to their total absolute magnitude or linear dimensions.

A NEW GENERAL CATALOGUE OF NEBULAE.

By Knut Lundmark.

Work is going on at Upsala, Lund, and Mount Wilson for a new general catalogue of nebulae. All published data are compiled on cards with headings for visual and for photographic measures and estimates. Data for numerous "small" nebulae have been collected from Mount Wilson plates, relating generally to objects of total magnitudes 14-19. The plates are examined as completely as possible in order to establish a number of "Selected Areas" for the nebulae.

The principal data in the new catalogue refer to such characteristics as angular size of major and minor axes, apparent brightness, be it surface or total, form, area, orientation of the major axis, degree of concentration, and different classifications of type. Besides, a number of new characteristics have been introduced and sought for, such as: (a) *the length of the spiral arms*, expressed in terms of the major axis; (b) the *compressibility*, being a measure of the rate of the increase of

luminosity from the border of the objects towards the center; (c) the *index of asymmetry*, expressing the shift of the center of luminosity from the geometrical center of the objects; (d) the *light* and other characteristics of *secondary nuclei* in the objects.

The catalogue will contain at least 30,000 objects, possibly more. When the data have been compiled and the results of the principal observers have been worked together into a homogeneous system, The General Catalogue of Nebulae of the Observatory of Lund (L.G.C.) will be published and distributed. It is intended to consist of two parts, the first being the general catalogue, giving the description and other data finally adopted, the second giving a collection, as complete as possible, of all observations and contributions.

The extensive card index, being the foundation of L.G.C., will be kept at Lund and future observations and results will be inserted. The observatory will be glad to provide information, free of cost, to workers in this field. Suggestions and criticisms will be welcomed.

ANNUAL VARIATIONS OF UNDERGROUND AZIMUTH MARKS.

By W. S. McClenahan.

For the purpose of keeping a close check on the azimuth correction to the meridian circle at Ottawa, readings are taken on the azimuth marks. The north mark is placed at the principal focus of a collimating lens mounted on the north collimator pier and is 250 feet from the telescope. The south mark is 160 feet south of the telescope and is at the principal focus of a collimating lens mounted on the south collimator pier.

Each of the marks and collimating lenses is mounted on a slide equipped with a micrometer, so that its position may be referred to the center of a lens at the base of each pier. Readings are taken on these three times a week and all the azimuth corrections are referred to these underground marks.

From a series of readings taken over the past six years it develops that the mean azimuth defined by the marks suffers an annual oscillation of about two-tenths of a second of time, or three seconds of arc. This is about ten times the amount to be expected from the variation of latitude.

ZONE DIFFERENCES IN RIGHT ASCENSION.

By R. J. McDiarmid.

The Dominion Observatory, Ottawa, during the International Longitude work of 1926, used four transit instruments. The meridian circle of 6-inch aperture and a 3-inch Cooke transit were used at Ottawa, while at the Vancouver station there were used a 3-inch Cooke and a 1.75-inch Heyde. The program of the meridian circle included stars from $-20°$ to $+60°$ declination, while the Cooke programs included stars from $+15°$ to $+40°$, and the Heyde from $+20°$ to $+60°$ declina-

tion. The meridian circle list included all stars observed with the smaller instruments.

The residuals of the 2,000 meridian circle observations, grouped in zones of 10° declination, are as follows:

Zone	Residual	Zone	Residual
−20° to −10°	+.035	+20° to +30°	−.012
−10° to 0°	+.011	+30° to +40°	+.004
0° to +10°	−.001	+40° to +50°	+.008
+10° to +20°	−.004	+50° to +60°	−.012

Positive residuals indicate that the tabular right ascensions are too large.

All four instruments agreed in showing a break in Eichelberger's tabular right ascensions between the zones 20° to 30° and 30° to 40°; a similar break between the zones 40° to 50° and 50° to 60° was shown by the meridian circle and the Heyde transit, the only instruments which covered that interval.

NOTE ON THE LIGHT AND VELOCITY CURVES OF EPSILON AURIGAE.

By D. B. McLaughlin.

This discussion is based on the writer's radial velocities and photometric measures and upon photoelectric measures by Stebbins and Huffer and Güssow.

Observations made between September, 1927, and May, 1928, show that the 4- or 5-month velocity variation of Epsilon Aurigae found by Ludendorff is synchronous with the supposed irregular light variations measured many years ago by Wendell and more recently by Stebbins and Huffer and Güssow. The maximum velocity of approach occurs about a third of a period later than the maximum of light. The relation of light and velocity curves is thus somewhat different from that which obtains for the Cepheid variables. However, light and velocity curves of R Scuti determined by R. H. Curtiss show a relation very similar to this, the lag being a fifth of the period.

It is found that the normal Cepheids, as well as β Cephei, 12 Lacertae, RR Lyrae, R Scuti, Epsilon Aurigae, and Mira show a very definite relation between length of period and lag of velocity minimum after light maximum, when this lag is expressed in terms of the period as unit. For the stars with periods about 5 days (rather significantly the period of maximum frequency of the Cepheids) the lag is very small (0.01 P) and it increases for both long and short periods, reaching 0.20 for β Cephei and 12 Lacertae ($P = 0^d.19$ and $0^d.20$) and 0.6 P for Mira ($P = 330^d$). As Epsilon Aurigae fits this relation very well, it is concluded that its light and velocity variations are to be traced to the same causes as those of the Cepheids and Mira variables. The full details of this relation will appear at an early date in the *Astronomical Journal*. The short-period variations of Epsilon Aurigae also fit Luden-

dorff's relation: $2K = 47.3\,A$ which holds for the Cepheids, where K is the semi-range of velocity and A the range of magnitude.

The "constant" phase of minimum was reached about the end of October, 1928. The brightness increased from that time to the end of April, 1929, through several hundredths of a magnitude, with possibly some small fluctuations. In August, 1929, it was again as faint as in November, 1928. These fluctuations of light are possibly associated with velocity variations of smaller amplitude than those characteristic of the star outside of minimum.

The hydrogen lines show anomalous variations of velocity. The most remarkable change occurred between April and July, 1929, when they suffered a shift, relative to the remainder of the spectrum, of about —15 km, or roughly 0.2 A towards the violet. This is accompanied by a very conspicuous intensification of these lines which, in the case of Hγ, is clearly due to a widening of the line on the side of smaller wavelength, suggesting the anomalous absorption which occurs in β Lyrae just after principal minimum. λ 4227 of calcium possibly varies in intensity synchronously with the short-period light changes, being strengthened at light minimum.

A NOTE ON THE EMISSION LINES IN BETA LYRAE.

By Laura Hill McLaughlin.

In the line H-beta of the spectrum of Beta Lyrae, the oscillating line of the B8 dark-line spectrum is missing. There are present the non-oscillating B5 dark-line spectrum and the non-oscillating emission band. Twenty-five spectrograms made with the two prism spectrograph in 1927 furnished material for a micro-photometric study of the line H-beta. The deflection curves were changed into intensity curves by means of a sensitometer calibration curve. The line variations in these curves were referred to the continuous spectrum.

A study of the intensity curves referred to the continuous spectrum shows for the emission components and the central absorption a curve which is the inverse of the light curve of Beta Lyrae, when the intensities are plotted against the phase. The emission on the redward side was then assumed to be constant and the intensities of the various points on the continuous spectrum were referred to it. These values when plotted against the phase show a light curve which agrees fairly well with the ordinary light curve of the star, Beta Lyrae. This shows that the emission spectrum is constant in intensity and suggests that it has its origin in an envelope common to the two stars which form the Beta Lyrae system and which are the sources of the B5 and B8 spectra.

CANADIAN INVESTIGATIONS IN GRAVITY.

By A. H. Miller.

Gravity work was begun by the Dominion Observatory in 1902 and has been carried on at intervals since, until now well over one hundred

accurately determined stations have been established. The greater part of these are in Western Canada. The base station is at Ottawa, which has recently been connected by relative measurements with Potsdam, Greenwich, and Washington.

The isostatic anomalies are on the whole rather small. This is particularly true of the mountainous and elevated regions of British Columbia and Alberta. A network of stations has been carried across the country from the Atlantic to the Pacific. The survey has been extended to the Arctic ocean by way of the Mackenzie river and along the Pacific coast.

In all of Western Canada there are only two regions of definite isostatic anomaly, both positive. The anomalies on the southern part of Vancouver island are apparently due to abnormally heavy rock beneath the stations.

It has been concluded that the larger Saskatchewan anomalies are probably due to an extension of the Cambrian floor which is exposed in the Black Hills region, rather than to a lack of isostatic equilibrium.

It is possible that the general tendency to small positive anomalies over this region may represent a departure from isostatic equilibrium and may possibly be related to glaciation.

A graphical determination from the results of 20 stations in the mountains gives a depth of approximately 100 kilometers for the depth of compensation.

Investigations in Canada with torsion and magnetic balances have been begun as an application of geophysical methods of prospecting.

SUN-SPOTS AND TREE-GROWTHS IN CANADA.

By J. L. O'Connor and R. E. DeLury.

Measurements were made, from photographs, of the widths of the annual growth-rings in a section of a pre-glacier spruce recently released by the recession of the glacier in northern British Columbia (Tarr Inlet), 4 sections of spruces cut in 1928 and supplied by the Lower Ottawa Forest Protective Association, and a section of a butternut tree cut at the Experimental Farm, Ottawa, in 1929. All show a mean 11.5-year variation corresponding to the sun-spot curve. The pre-glacier spruce has a difference of 18 per cent between mean minimum and maximum growths, the 4 spruces from Quebec, 22 per cent, and the butternut over 50 per cent. It is of interest that the pre-glacier spruce, which grew probably many thousands of years ago, shows evidence of a sun-spot influence similar to that shown to be present in the trees of today.

THE AIMS AND POLICIES OF THE GEODETIC SURVEY OF CANADA.

By N. J. Ogilvie.

The aims and policies of the Geodetic Survey of Canada are to help in the development of Canada's industries and natural resources. It provides an accurate basis for all surveys in Canada so that any accumulative errors of various surveys will be localized and thus will not cause serious discrepancies in the production of maps and charts. Briefly, in its importance a geodetic survey may be likened to the steel framework of a structure as all other surveys are dependent on it.

The principal functions of the Geodetic Survey of Canada are the obtaining of precise geodetic latitudes and longitudes of points throughout the Dominion of Canada, together with its coast-lines and large waterways; the determination of elevations of points above mean sea-level; to serve as a horizontal and vertical control for all kinds of engineering work; to assist in the determination of the size and shape of the earth; to investigate such scientific problems as may arise, e.g. the theory of isostasy, etc.

The study of the horizontal and vertical movements of earthquakes is now being effected by coöperation with the Dominion Observatory, the Geodetic Survey of Canada, in the case of the St. Lawrence river area where an earthquake occurred in 1925, doing the triangulation work and also putting in lines of levels, while the noting of the seismological disturbances was done by the Dominion Observatory.

By the introduction of the airplane into the triangulation work, it is hoped that routes most suitable for triangulation nets may be selected and in fact much of the actual reconnaissance as well as the transportation of triangulation parties in out of the way districts may be done from planes, thus speeding up the work.

(To be continued)

PHENOMENA FOR 1930.

By LOUIS BERMAN.

Eclipses.

There will be four eclipses during the year 1930, two of the sun and two of the moon. The information concerning the circumstances of the eclipses together with Figures 1 and 2 has been taken from the *American Ephemeris and Nautical Almanac*.

I. A Partial Eclipse of the Moon, April 13, 1930.

The beginning visible generally in the southwestern part of Europe, northwestern part of Africa, the Atlantic Ocean, North America, South America, and the Pacific Ocean except the western part; the ending visible generally in the

Atlantic Ocean, North America, South America, and the Pacific Ocean except the western part.

Circumstances of the eclipse:

	Greenwich Civil Time		
	d	h	m
Moon enters penumbra	April 13	3	42.9
Moon enters umbra	13	5	20.7
Middle of eclipse	13	5	58.2
Moon leaves umbra	13	6	35.6
Moon leaves penumbra	13	8	13.8

To obtain the local time at the place of observation one has but to add his longitude from Greenwich to the time of prediction.

CENTRAL ECLIPSE OF APRIL 28, 1930

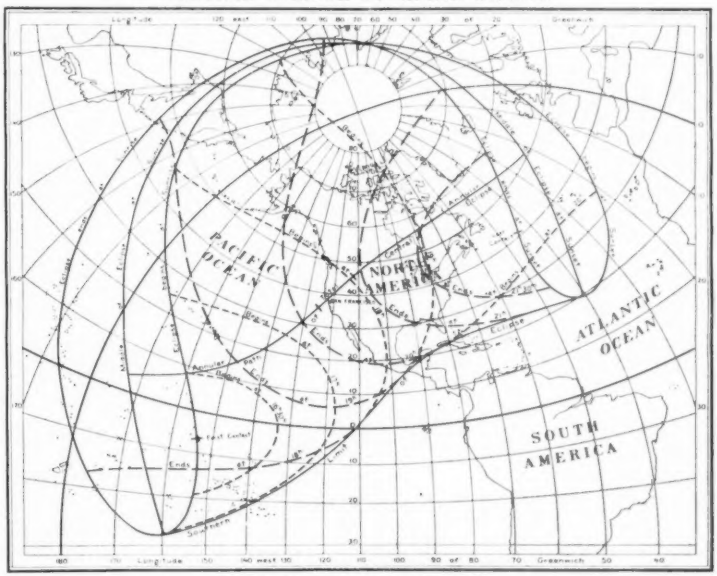

FIGURE 1.

II. A CENTRAL ECLIPSE OF THE SUN, APRIL 28, 1930.

The central line of the eclipse extends from a point just north of Christmas Island in the Pacific Ocean and continues in a northeasterly direction entirely over water, thence passing slightly north of San Francisco, over Northern California, northwest Nevada, the southeasterly tip of Oregon, central Idaho and Montana, into Canada and the south Hudson Bay region, finally ending in the Atlantic Ocean south of Greenland. The eclipse will be annular except for a small strip of approximately 1000 miles where it will be total, the greater part of which is over land. The shadow of the moon will first touch the earth in the Pacific Ocean some 270 miles southwest of San Francisco, the eclipse changing from annular to total. The eclipse will then continue total along its path as far as southwest Montana where the moon's shadow leaves the earth at midday after which it becomes annular again. As a partial eclipse it will be seen over nearly all of North America, Greenland, at the North Pole, and a small part of Siberia

occurring there on the following day. In a certain restricted north polar region it will even be visible at midnight. The maximum duration of totality which occurs at Black Rock Desert, Nevada, is only 1.5 seconds; north of the San Francisco Bay region the eclipse will be total for 1.1 seconds. Thus it is possible to miss the time of totality completely since the uncertainties in the solar and lunar tables may cause unavoidable errors of a few seconds to exist in the predicted times. A very accurate determination of the central path of totality is therefore necessary as otherwise the observer may find himself outside the narrow limits of totality.

The only definite information that has come to hand regarding observers' plans is that the Lick Observatory will send an expedition to Camptonville, Calif., for the purpose of making spectrographic observations mainly, because of the short duration of the eclipse. Dr. Moore, who will be in charge of the expedition, and Dr. Menzel will try to photograph the flash spectrum. According to Dr. Aitken an attempt will also be made by the Lick observers to obtain at least one photograph of the corona by employing three cameras set up on a line perpendicular to the shadow path at intervals of about one-third of a mile.

Circumstances of the eclipse:

	Greenwich C.T. d h m	Long. from Green. ° ′	Latitude ° ′
Eclipse begins	April 28 16 20.0	+153 56	— 6 41
Central eclipse			
Begins	28 17 25.7	+172 57	+ 3 32
Changes from annular to total	28 18 48.8	+125 29	+35 28
Changes from total to annular	28 19 26.9	+112 23	+45 40
At local apparent noon	28 19 26.9	+112 22	+45 41
Ends	28 20 40.1	+ 22 44	+50 46
Eclipse ends	28 21 45.9	+ 44 30	+40 56

The following table gives the standard times at the middle of the eclipse and the magnitude of maximum partial eclipse for various localities:

Place	Middle of Eclipse S.T.	Magnitude	Place	Middle of Eclipse S.T.	Magnitude
Allegheny, Pa.	3:18 p.m.	0.55	Minneapolis, Minn.	1:58 p.m.	0.77
Amherst, Mass.	3:29 p.m.	0.58	Mt.Hamilton,Calif.	10:58 a.m.	0.97
Ann Arbor, Mich	2:12 p.m.	0.62	Mt.Wilson, Calif.	10:58 a.m.	0.85
Berkeley, Calif.	10:58 a.m.	0.99	New Haven, Conn.	3:28 p.m.	0.55
Boise City, Idaho	11:18 a.m.	0.99	New York, N. Y.	3:27 p.m.	0.54
Cambridge, Mass.	3:30 p.m.	0.58	Omaha, Nebr.	1:50 p.m.	0.69
Cincinnati, Ohio	2:10 p.m.	0.53	Portland, Ore.	11:12 a.m.	0.86
Denver, Colo.	12:31 p.m.	0.76	Sacramento, Calif.	11:01 a.m.	0.99
Evanston, Ill.	2:06 p.m.	0.64	Salt Lake City,Utah	12:20 p.m.	0.88
Flagstaff, Ariz.	12:11 p.m.	0.76	Seattle, Wash.	11:15 a.m.	0.83
Helena, Mont.	12:29 p.m.	0.98	St. Louis, Mo.	1:59 p.m.	0.56
Iowa City, Iowa	1:58 p.m.	0.66	Washington, D. C.	3:23 p.m.	0.49
Madison, Wis.	2:03 p.m.	0.68	Williams Bay, Wis.	2:04 p.m.	0.66

III. A Partial Eclipse of the Moon, October 7, 1930.

The beginning and ending visible generally in Asia, Australia, the Indian Ocean, Europe, and Africa.

Circumstances of the eclipse:

	Greenwich Civil Time d h m
Moon enters penumbra	Oct. 7 16 41.3
Moon enters umbra	7 18 46.2
Middle of eclipse	7 19 6.5
Moon leaves umbra	7 19 27.0
Moon leaves penumbra	7 21 31.9

IV. A TOTAL ECLIPSE OF THE SUN, OCTOBER 21-22, 1930.

This eclipse will be difficult to observe as the path of totality lies almost entirely over water. The central line of the eclipse extends from a point in the Pacific Ocean several hundred miles north of New Guinea, pursuing its southeasterly

TOTAL ECLIPSE OF OCTOBER 21-22, 1930.

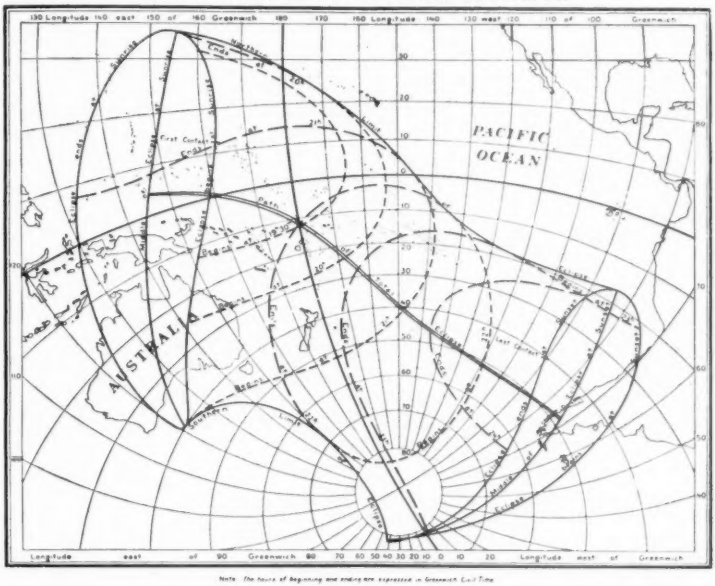

FIGURE 2.

course between the Fiji and Samoa Islands, and ending at sunset off the west coast of South America at its southern extremity. The maximum duration of totality will be $1^m\ 55^s.3$ at longitude $+160°\ 37'.2$, latitude $-31°\ 0'.2$. As a partial eclipse it will be visible over a large part of Australia, New Guinea Isands, New Zealand, Samoa and Fiji Islands, southern tip of South America, and at the South Pole.

Circumstances of the eclipse:

	Greenwich C.T.	Long. from Green.	Latitude
	d h m	° ′	° ′
Eclipse begins	Oct. 21 19 3.9	—162 34	+12 18
Central eclipse begins	21 20 4.8	—145 48	+ 4 17
Central eclipse at local apparent noon	21 22 3.7	+154 45	—36 6
Central eclipse ends	21 23 21.8	+ 72 6	—48 6
Eclipse ends	22 0 22.8	+ 90 18	—40 15

THE SUN.

On January 3 at 12^h Greenwich Civil Time the sun will be closest to the earth. Spring commences on March 21, $8^h\ 30^m$ G.C.T., when the sun enters the sign of Aries, crossing the equator from south to north. On June 22, $3^h\ 54^m$ G.C.T., the sun enters the sign of Cancer and summer begins. It is then at its greatest distance north of the equator. The sun will be farthest from the earth on July 3,

0^h G.C.T. Autumn begins on September 23, $18^h\ 37^m$ G.C.T., the sun now crossing the equator from north to south to enter the sign of Libra. Winter begins when the sun, entering the sign of Capricornus, will have reached its farthest point south of the equator on December 22, $13^h\ 40^m$ G.C.T.

The Planets.

Planetary configurations.

The meaning of the various terms used in describing the position of a planet with respect to the sun as seen from the earth is as follows:

Inferior conjunction occurs when the planet is between the earth and sun—a configuration possible only for Mercury or Venus; superior conjunction when the planet is beyond the sun and in line with the earth and sun. Opposition occurs when the earth is between the planet and sun—a position possible only for a superior planet; quadrature when the angle between the lines drawn from the earth to planet and to sun is equal to 90°. The angular distance of a planet from the sun is called its elongation. The elongation of a superior planet may reach any value from 0° to 180°; that of an inferior planet must have a maximum value less than 90° known as the greatest elongation, east or west—the angle between the tangent to the planet's orbit drawn from the earth and the line from earth to sun. The inferior planets are best visible near greatest elongation, either in the evening or morning twilight since they are farthest from the solar glare at this time.

A superior planet beginning at superior conjunction is at its greatest distance from the earth and cannot, of course, be seen because of its apparent proximity to the sun. Owing to the fact that the sun is moving eastward among the stars faster than it, the planet will shortly thereafer be seen as a morning star. As the planet approaches the earth it will reach western quadrature and rise at midnight. At opposition it will be closest to the earth after which it will recede, passing through eastern quadrature at which time it sets at midnight. Finally, the planet will disappear as an evening star in the glare of the setting sun thus completing its synodic period when it has reached superior conjunction again.

An inferior planet, as seen from the earth, appears to swing back and forth across the sun, going out nearly equal distances on either side of the sun. At superior conjunction, since the planet is moving eastward faster than the sun it will soon appear to the east of the sun as an evening star. It will continue to increase its angular distance from the sun until the point of greatest eastern elongation is reached after which it will begin to approach the sun and pass through inferior conjunction, its closest distance to the earth. From there it moves out as a morning star on the other side of the sun toward its greatest western elongation, then again approaches sun finally completing its synodic period of revolution when it has returned to superior conjunction. The inferior planets as seen from the earth possess moon-like phases depending upon their elongation. At superior conjunction the phase is full; at inferior conjunction it is new. Between superior conjunction and greatest elongation the phase is gibbous; at greatest elongation it is quarter; and between greatest elongation and inferior conjunction it is crescent. As the phases successively pass from that of full to new the apparent diameter of the planet increases until inferior conjunction is reached; after that it appears to diminish in size as the phases now pass from new to full.

Since the orbits of the planets are very nearly in the plane of the earth's orbit, they will be seen edgewise along the ecliptic by an observer on the earth. The planet's own motions about the sun coupled with that of the earth's motion cause their apparent paths in the sky to be somewhat complicated by the addition of

kinks and loops depending upon their movements relative to the earth. (The background of Figures 3 and 4 showing the apparent paths of the planets among the stars has been prepared by the Eastern Science Supply Co., Chart SC1.) In Figure 3 the printed lettering gives the position of Mercury at the beginning of each month; the handscript lettering the position of Mars at the beginning of each month. Figures 5 to 8, showing the apparent orbits of the satellites of the major planets, have been taken from the *American Ephemeris and Nautical Almanac* for 1930.

MERCURY.

On January 1, Mercury will be found west of the constellation Capricornus in conjunction with the new moon. The planet will move eastward until January 12 when it becomes stationary; from then on it will retrograde, becoming stationary again on February 2; after forming a loop near Capricornus the planet continues eastward, closely following the ecliptic; on May 9 it reaches a stationary point not far from the Pleiades and retrogrades until June 1 when it again becomes stationary; it then proceeds eastward through Taurus, Gemini, Cancer, and Leo, and, after becoming stationary on September 8 and retrograding, forms another loop in Virgo; on September 30 it advances eastward again through Libra and Scorpio, and at the close of the year will be found west of Sagittarius not far from where it started the year. Mercury will be at inferior conjunction on January 22, May 20, and September 21; at superior conjunction on April 1, July 15, and November 7.

Greatest Elongation East.
Mercury visible as an evening star.

Date	Dist. from Sun	Magn.
January 6	19° 15′	−0.3
April 27	20 33	+0.2
August 26	27 20	+0.5
Dec. 20	20 11	0.0

Greatest Elongation West.
Mercury visible as a morning star.

Date	Dist. from Sun	Magn.
Feb. 15	26° 14′	+0.2
June 15	23 16	+0.7
October 7	17 58	−0.2

VENUS.

At the beginning of the year Venus will appear in the constellation of Sagittarius as a morning object one-half degree north of Mars and one degree south of Saturn. It will be moving eastward in the sky, very close to the ecliptic, finally catching up with the sun on February 6 and reappearing on the other side of the sun as an evening star; on November 2 the planet will reach a stationary point not far from Antares, begin to retrograde into the constellation of Libra; passing between the earth and sun on November 22 it will again become a morning star, continuing its retrograde motion until December 22 when its motion becomes direct after having completed a half loop. On September 13 Venus will be found at its greatest eastern elongation, 46° 22′ from the sun. At that time it will appear as a thin crescent of magnitude −4.0. Its greatest brilliancy will occur on October 18 as an evening star and on December 28 as a morning star when its magnitude is between −4.3 and −4.4. At its brightest Venus is capable of casting a shadow and can easily be seen with the naked eye in full daylight if one knows where to look for it. The planet will be at superior conjunction on February 6 and at inferior conjunction on November 22.

MARS.

Mars will be found in Sagittarius during January. It will be travelling eastward among the stars continuously and will keep close to the ecliptic. On March 1,

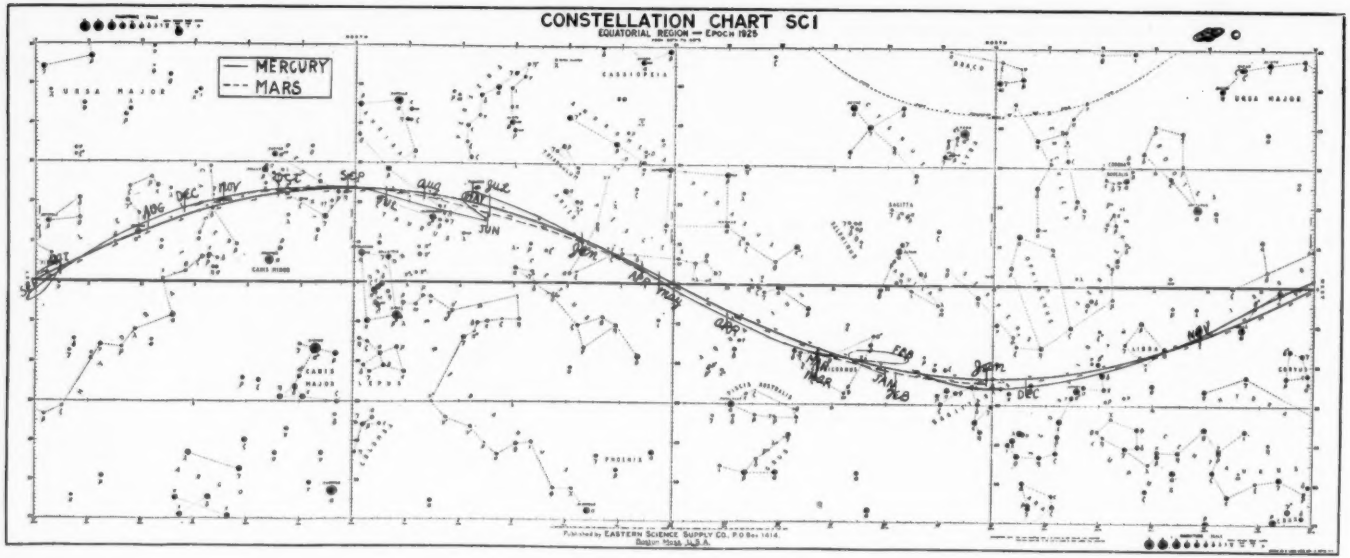

FIGURE 3.

APPARENT PATHS OF THE PLANETS MERCURY AND MARS AMONG THE STARS DURING THE YEAR 1930.

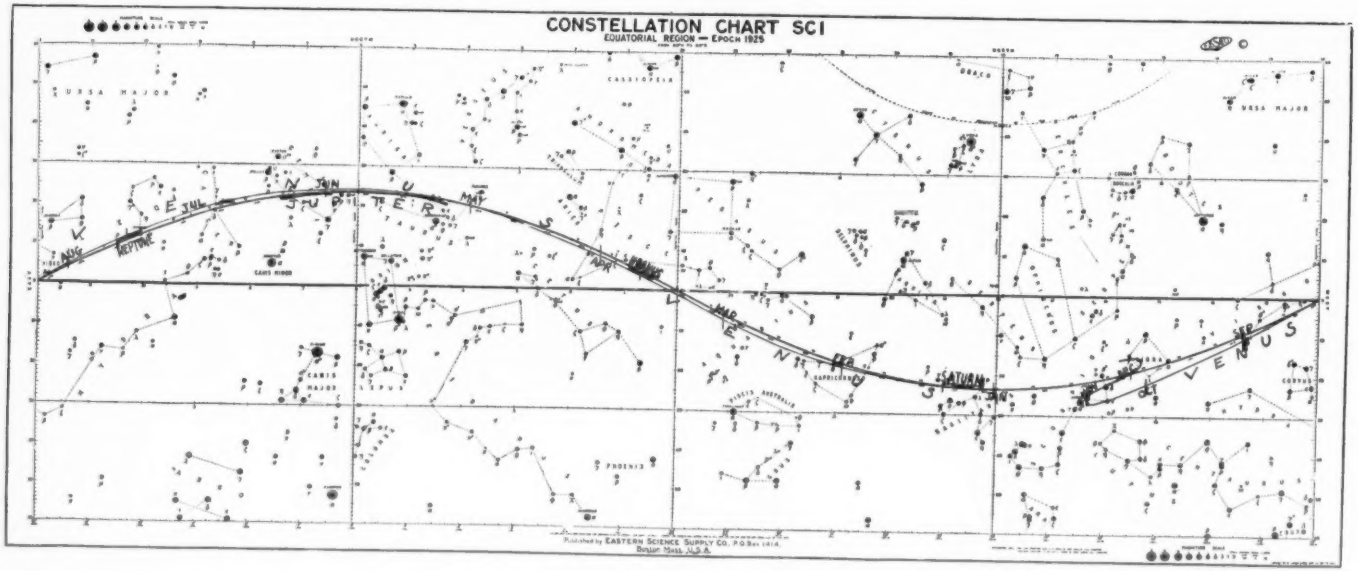

FIGURE 4.

APPARENT PATHS OF THE PLANETS VENUS, JUPITER, SATURN, URANUS, AND NEPTUNE AMONG THE STARS DURING THE YEAR 1930.

Mars and Mercury will be one-half degree from each other (the former much fainter than the latter) appearing as morning objects about 20 degrees from the sun; on October 27 the planet will be at western quadrature and will therefore rise at midnight; it will end the year in Cancer, reaching a stationary point there on December 19 and then retrograding as it is about to make a loop in its motion.

The most favorable time for viewing Mars in the telescope will be at the close of the year when it is nearing opposition. On December 1 the planet will present a disk 10″ in diameter, of magnitude 0.0. Its distance from the earth will have decreased from 225,000,000 miles in January to 70,000,000 miles in December.

Mars is always an interesting object in the telescope. Its general color is ruddy and it appears to be girded with a dark blue-gray belt of vegetation whose size, color, and shape vary with the Martian seasons. The most conspicuous features on the disk are the snow white polar caps also subject to regular seasonal changes. In the winter hemisphere the cap will attain its largest extent during the Martian winter, gradually fading away as spring approaches, and finally disappearing with the advent of the Martian summer.

JUPITER.

Jupiter will begin the year in Taurus several degrees north of Aldebaran. It will retrograde and become stationary on January 31 after which its motion is direct; on February 26 it will be at eastern quadrature, setting at midnight; on

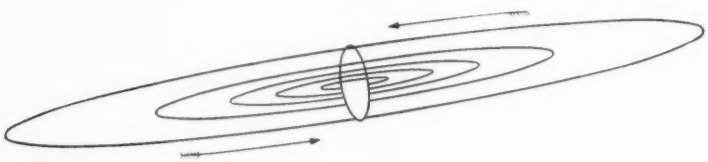

FIGURE 5.

Apparent Orbits of the Satellites of Jupiter at date of opposition, January 6, 1931, a sseen in an inverting telescope and elongated in the ratio of three to one in the direction of their minor axes.

June 20 it will be at superior conjunction and at its farthest distance from the earth, approximately 570,000,000 miles; from then on it will gradually approach the earth, arriving at western quadrature on October 13; on November 8 the planet will reach a stationary point in the constellation of Gemini, turn about and move westward at the end of the year. Opposition will not occur until January 6, 1931.

The planet will be favorably situated for observation during the winter months when it will be at its least distance from the earth and highest in the sky for northern observers. Jupiter is an easy object to observe even in a small telescope. With a magnifying power of one hundred it appears larger than the moon does to the naked eye. The disk is streaked with wide reddish brown belts running parallel to the planet's equator.

Jupiter possesses nine satellites but only the four brightest, discovered by Galileo, can be seen with the ordinary telescope. The amateur will find it very

instructive to watch the movements of these satellites around Jupiter, from night to night. Their orbits are nearly in the plane of Jupiter's orbit so that the satellites are continually being eclipsed by the planet's shadow at every revolution as they pass behind the planet. At opposition, however, when the shadows are directly behind, occultations of the satellites may be observed as the satellites move across the disk of Jupiter, when their shadows are cast upon the planet and are easily visible in the telescope as black dots. A transit of a satellite itself is much more difficult to observe. The times of eclipses, occultations, and transits of the satellites and their shadows across Jupiter's disk can be found in the *Nautical Almanac* every year.

SATURN.

Saturn will remain in the constellation of Sagittarius during the year. Its motion will be direct until April 15; after that it retrogrades until September 9 and then moves eastward again for the remainder of the year; on April 2 it will be at western quadrature; on July 1 at opposition at which time its distance from the earth is 838,000,000 miles; and on September 29 at eastern quadrature.

Because of the low altitude this planet will not be a favorable object for observation in the north temperate zone. On account of its ring system Saturn is considered by many to be the finest telescopic object in the sky. The ring system

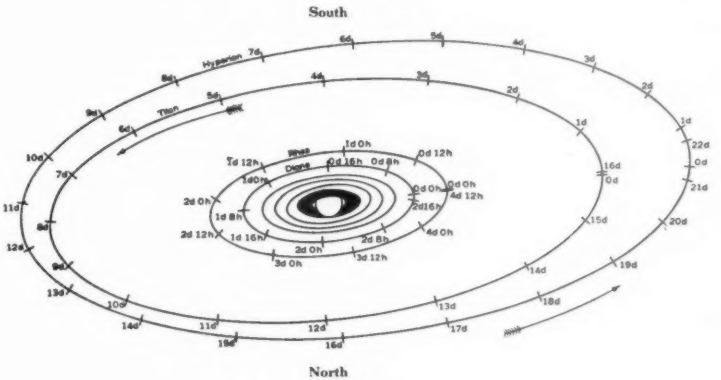

FIGURE 6.
Apparent Orbits of the Seven Inner Satellites of Saturn at date of opposition, July 1, 1930, as seen in an inverting telescope.

is composed of three separate rings from 10 to 20 miles thick; the inner "gauze" ring which can be seen only with large telescopes and the two outer rings separated by a space known as Cassini's division. The rings themselves consist of tiny separate particles revolving about the planet in circular orbits, the inner particles moving faster than the outer ones in accordance with Kepler's harmonic law. The plane of the rings shown in Figure 6 is tipped up at its greatest angular extent. In this position the maximum width of the ring system is about half its length. The northern surface of the rings is now visible.

URANUS.

Uranus will spend the year in the constellation of Pisces, advancing eastward until July 21 and then retrograding until December 21 after which it will

advance again. The planet will be at western quadrature on July 8; at opposition on October 7 when its distance from the earth will be 1,766,000,000 miles. It will then present a greenish disk, 3".6 in diameter, and be barely visible to the naked eye as a sixth magnitude object a few degrees north of the equator. Uranus possesses four satellites which can be observed only in powerful telescopes under fine conditions of seeing. A curious feature of the satellite system is that the moons all revolve backward around the planet.

NEPTUNE.

Neptune, invisible to the naked eye, will appear in the constellation of Leo during the entire year. Its motion at the beginning of the year will be westward, the planet passing two degrees southeast of Regulus; it reaches a stationary point on May 12 after which it will advance eastward until December 9 when it will retrograde again; Neptune will be at opposition on February 21 when its distance

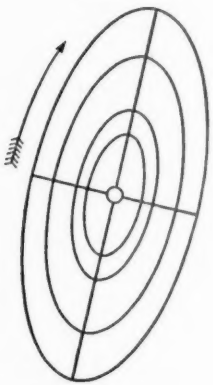

FIGURE 7.

Apparent orbits of the Satellites of Uranus at date of opposition, October 7, 1930, as seen in an inverting telescope.

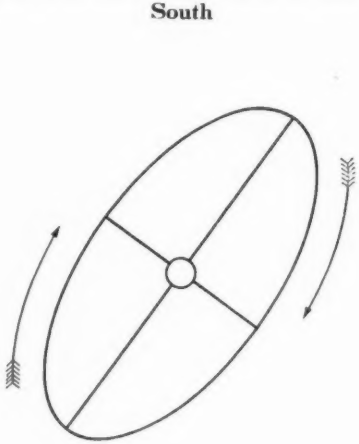

FIGURE 8.

Apparent orbit of the Satellite of Neptune at date of opposition, February 21, 1930, as seen in an inverting telescope.

from the earth will be 2,700,000,000 miles; at eastern quadrature on May 22; at superior conjunction on August 27; and at western quadrature on November 22.

Since the apparent angular diameter of the planet is only 2".5 at opposition (magn. 7.7) it will take a telescope of considerable aperture to see it as a disk. The lone satellite revolves backward around the planet and can just be glimpsed with a 10-inch telescope.

OCCULTATIONS.

A list containing the elements for the prediction of the times of occultations of stars and planets by the moon during the year can be found in the *American Ephemeris and Nautical Almanac*. The only occultation of a first magnitude star

observable in the United States will be that of Antares on the afternoon of October 24. The occultations visible at Washington, as given in the *American Ephemeris*, will be published as heretofore from month to month, one month in advance.

The comet notes by Professor G. Van Biesbroeck and the meteor notes by Professor Charles P. Olivier will be continued from month to month in POPULAR ASTRONOMY during the current year. Further information regarding many other kinds of interesting phenomena for 1930 may be found in the *British Astronomical Association Handbook for 1930* and the *Observers Handbook* published by the Royal Astronomical Society of Canada.

PLANET NOTES FOR FEBRUARY.

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast from the central part of Capricornus to the central part of Aquarius. The position of the sun on the first and the last day of the month will be, respectively, R.A. $20^h\ 55^m$, Decl. $-17°\ 22'$; and R.A. $22^h\ 41^m$, Decl. $-8°\ 19'$.

The phases of the *Moon* will occur as follows:

First Quarter	Feb. 6 at 11	A.M.	C.S.T.
Full Moon	13 " 3	A.M.	"
Last Quarter	20 " 3	A.M.	"
New Moon	28 " 8	A.M.	"

Perigee will occur on February 12, and apogee on February 25.

Mercury will be a morning star during this period. After the first day of the month its apparent motion will be direct, but its apparent motion will not be as great as that of the sun until after February 15 at which time Mercury will be at greatest elongation west. On this date Mercury will rise about an hour and a half before the sun.

Venus will be near the sun in apparent position during this period, superior conjunction occurring on February 6.

Mars will be in Capricornus, and its apparent motion will be easterly from the western to the eastern part of the constellation. Its apparent position will be near that of the sun. At the beginning of the month it will rise about an hour before the sun.

Jupiter will be in Taurus about five degrees north of Aldebaran. During this period it will be prominent in the evening sky, setting somewhat after midnight. Jupiter will be in conjunction with the moon on February 8. On February 26 it will be in quadrature east of the sun. Its apparent motion during this period will be retrograde.

Saturn will be in Sagittarius. Its apparent motion will be eastward. During the middle of the month it will rise about three hours before the sun. On February 23 it will be in conjunction with the moon.

Uranus will be in central Pisces. It will be an object in the early evening sky during this period, setting about three hours after the sun during the middle of the month. It will be in conjunction with the moon on February 3.

Neptune will be in Leo near Regulus. It will be above the horizon practically all night long for observers in the northern hemisphere, opposition occurring on February 4. Conjunction with the moon will occur on February 13. Its apparent motion during this period will be retrograde.

OCCULTATIONS.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1930	Star's Name	Magnitude	IMMERSION Washington C.T.	IMMERSION Angle from N	EMERSION Washington C.T.	EMERSION Angle from N	Duration
			h m	°	h m	°	h m
Feb. 2	4 Ceti	6.3	20 3	41	21 1	258	0 58
2	5 Ceti	6.3	20 24	34	21 17	266	0 54
5	29 Arietis	6.1	23 44	76	0 39	250	0 55
11	*c* Geminorum	5.5	2 22	89	3 17	307	0 55
22	*X* Sagittarii	4.4	4 1	45	4 38	346	0 38

Prediction of Occultations for Amherst, Mass., and Vicinity.

(Disappearances Only)

Date 1930	Star	Mag.	G.C.T.	*a*	*b*	P
			h m	m	m	°
Feb. 11	*c* Geminorum	5.5	6 49	−0.9	−0.8	73

The G.C.T. of the occultation at some other station within 300 miles of Amherst may easily be found from the coefficients a and b and the formula

$$\text{G.C.T.} = \text{Predicted G.C.T.} + a\Delta\lambda + b\Delta\phi,$$

where $\Delta\lambda$ is equal to the longitude of the place (to tenths of a degree) minus the longitude of Amherst (72.5 degrees) and $\Delta\phi$ is equal to the latitude of the place (likewise to tenths of a degree) minus the latitude of Amherst (42.2 degrees). For distances up to 300 miles the error of this formula will rarely exceed 2^m.

ROY MARSHALL.

Detroit Observatory, Ann Arbor, Michigan.

Occultations Visible at Omaha and Vicinity.

The following list gives the Greenwich Civil Times and position angles of the most favorable occultations visible at Omaha (long. = 96°0, lat. = 41°3) during January and February. The approximate times for observers within 300 miles of Omaha can be found by using the constants a and b, given in the table, according to the formula indicated above for the occultations visible at Amherst, $\Delta\lambda$ and $\Delta\phi$ in this case being obtained by using the given longitude and latitude of Omaha.

a and b were omitted in the second occultation on account of its short duration.

Date 1930	Star	Mag.	G.C.T.	*a*	*b*	P
			h m	m	m	°
Jan. 6	351 B. Aquarii	6.5	0 16	−2.2	+0.1	85
11	22 H.[1] Tauri	6.1	3 41			124
12	κ Tauri	5.6	9 28	+0.2	+0.6	118
14	47 Geminorum	5.6	8 24	−1.6	+0.5	66
Feb. 3	4 Ceti	6.3	1 5	−0.3	+3.1	11
3	5 Ceti	6.3	1 31	−0.1	+2.7	7
6	29 Arietis	6.1	4 45	−0.5	−1.0	78
11	*c* Geminorum	5.5	7 9	−1.2	+0.1	111

WM. CLETUS DOYLE, S. J.

Creighton University Observatory.

METEOR NOTES.

By CHARLES P. OLIVIER.

The brilliant moonlight which so interfered with the maxima of both the Orionid and Leonid streams had the expected effect of cutting down greatly the number of meteors reported, compared to more favorable years. However, particularly for the Leonids, many persons made observations. These observers were in no case largely rewarded, but the information gathered by them makes it a certainty that the 1929 shower was inferior to that of 1928. This latter, on the contrary, was much better than expected. Therefore certain predictions for 1932-34 are obviously impossible so far as these facts go.

In addition to A.M.S. members and others reporting directly to its headquarters, many persons reported to Harvard College Observatory. Through the coöperation of Director Harlow Shapley and Dr. W. J. Fisher, in direct charge of meteor investigations there, these reports are sent here for inclusion. They are kept in a group, proper acknowledgement being thus made, and they will so be found in the tables.

The Leonid radiants deduced from all maps received show a rather large area, perhaps 5° to 6° in diameter, on an average. We also know that the stream now is about 8 or 10 "days wide," in this part of it. Both of these facts point to dispersive actions. It is still too early to have reports from most ships, but one wonderful Leonid fireball was reported from two steamers, about 160 miles apart, on November 10 at 6:01 G.C.T. These ships were in the Caribbean Sea. Unfortunately, neither observation is quite complete, so any deduced path would be only approximate.

Reports are also at hand of a fine fireball that ended over central Arkansas at 9:15 C.S.T. on November 8. This fireball was not a Leonid, as is definitely proved by its direction of motion. A brief article on this has been published in the *Little Rock Gazette* by H. S. Cole of the U. S. Weather Bureau Office in that city. Mr. Cole's example in collecting and working up these data is to be heartily commended to others in similar positions.

O. E. Monnig of Ft. Worth, Texas, whose aid has been so invaluable in following up fireball observations, has gathered by correspondence and sent in a fine lot which refer to the brilliant meteor of July 10 at 9:45, which appeared over Ohio. He has already done most of the work on this, and as soon as possible it will be completed and published. Work on the great Illinois fireball of July 25 is slowly progressing. How to get the most out of the 400 or more observations available is no small problem—hence the delay. Monnig also investigated by numerous letters the reported fall of a meteorite at Beaumont, Texas, on February 24 at 10:00 P.M. The writer long since had received a fragment from a person who got it from an eye witness. The fragment looks almost like diamond, clear and of crystalline structure. The accounts seem authentic, but the fragment looks like no known meteorite. Just what conclusions to draw in such a case the writer frankly does not know, as the persons reporting do so in most evident good faith.

An article on the Leonid "shower" for this fall appeared about September 12-19 in many daily papers. It was based upon a longer one inspired last summer by the writer. However, it had been so "edited" by the last press agent who sent

it out that its whole meaning was changed and its contents made misleading, if not absurd.

Bad weather at Flower Observatory has completely ruined the chances for seeing the Geminid meteors. It is hoped that our members elsewhere have had better luck. We welcome as new members the following:

Leo Lawsine, 40 Harvard Street, Malden, Massachusetts.

Dr. Edgar N. Fought, 6630 Woodland Ave., Philadelphia, Pennsylvania.

Raymond H. Wilson, Swarthmore College, Swarthmore, Pennsylvania.

All members are urged to send in their 1929 observations in time for the annual report. This applies also to members of the A.A.V.S.O. who kindly send us their telescopic meteor observations.

R. A. McIntosh, Auckland, New Zealand.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Sept. 1	12:45	01:40	55	1.0	10	10.8	10.8	
2	02:54	04:20	86	1.0	15	10.5	10.5	
12	02:42	03:55	73	1.0	16	13.1	13.1	
30	02:25	04:15	110	1.0	18	9.8	9.8	
Oct. 5	02:30	03:05	35	1.0	3	5.2	5.2	
6	01:05	03:20	135	1.0	21	9.3	9.3	
7	02:30	04:05	95	1.0	17	10.8	10.8	
16	02:30	04:05	83	0.4	7	5.1	—	
17	03:05	03:45	40	0.4	2	3.0	—	
18	02:50	03:20	30	0.4	5	10.0	—	
19	03:05	03:25	20	0.4	3	9.0	—	
29	02:50	03:35	45	1.0	11	14.7	14.7	Two others

V. J. Niebuhr, Reedsburg, Wisconsin.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Nov. 4	12:04	13:04	60	1.0	17	17.0	17.0	All plotted
23	10:57	11:58	61	1.0	15	14.8	14.8	
24	8:15	9:15	60	1.0	7	7.0	7.0	

J. H. Darling, Duluth, Minnesota.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Aug. 11	14:05	15:05	60		12	12.0		10 Perseids
Nov. 14	14:30	15:30	60		1	1.0		
15	14:50	15:50	60		2	2.0		Leonids

Miss Leah B. Allen, Hood Observatory, Frederick, Maryland.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Nov. 14	13:15	15:15	120	0.3	7	3.5		

Franklin F. Marsh, Frederick, Maryland.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Nov. 15	13:15	15:15	120		10	5.0		Plotted

Miss Mary Anderson, Sinesbury, Connecticut.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Oct. 20	12:30	13:30	60	0.7	1	1.0	1.4	
Nov. 5	9:25	10:05	40	1.0	5	7.5	7.5	
19	9:45	10:10	25	0.7	1	2.5	3.6	

Dr. T. D. Cope, Wayne, Pennsylvania.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Aug. 10	12:30	14:00	90	0.7	14	9.3	13.3	Count

Andrew Thomas, Mrs. Thomas, Winnepegosis, Canada.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Aug. 11	12	12:30	30		30±			Count

Rev. R. G. Harbutt, Penney Farms, Florida.

1929	Began	Ended	Total	F	Meteors	Rate	Cor.Rate	Remarks
Dec. 5			30	1.0	5			Geminids

DR. JOEL STEBBINS, WASHBURN OBSERVATORY, MADISON, WISCONSIN.

1929	From	To	Total	Leonids	Other	Totals	Observers	Notes
Nov. 15	6:30	7:00	30	0	3	3	4	G.C.T. used
	7:00	7:30	30	2	1	3	3	
	7:30	8:00	30	1	1	2	10	
	8:00	8:30	30	4	5	9	18	
	8:30	9:00	30	2	0	2	6	
	9:00	9:30	30	2	0	2	4	
	9:30	10:00	30	8	3	11	8	
	10:00	10:30	30	6	3	9	5	
	10:30	11:00	30	4	2	6	5	
	11:00	11:30	30	7	1	8	4	
	11:30	12:00	30	5	1	6	3	
				41	20	61		
Nov. 16	7:10	8:10	60	0	1	1	2	
	8:10	9:10	60	2	2	4	1	Leonids=Jupiter
				2	3	5		

REPORTS RECEIVED THROUGH HARVARD OBSERVATORY.

MISS MARGARET HARWOOD AND 3, MARIA MITCHELL OBSERVATORY, MASS.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 15	14:00	14:30	30	0.5	0	1	1	Observer to quadrant
16	13:00	14:00	60	0.4	6	5	11	Fireball at 13:23
15 }					3	2	5	Casuals
16 }								
							17	

DR. W. J. FISHER, HARVARD COLLEGE OBSERVATORY, MASSACHUSETTS.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 15	14:50	17:00	118	0.5	9	0	9	5 were ≦1 magn.
15	11:35	12:01	26				4	by A. and W. Shapley.
15	15:	15:30	30				13	by M. Mayall.
15	11:30	12:	30	0.3			0	by Miss H. B. Sawyer.

L. A. CUNNINGHAM, T. JARMIN, E. M. LINDSAY, BLUE HILL OBS., MASS.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 15	14:30	15:00	30	0.5	6	0	6	2 Leonids earlier.
	15:00	16:00	60		14	4	18	
	16:00	17:00	60		13	0	13	
	17:00	18:00	60		17	1	18	
							55	

G. W. AND MRS. WHEELRIGHT, P. M. MILLMAN, MISS C. J. AUGER, BLUE HILL OBSERVATORY, MASSACHUSETTS.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 15	12:28	13:00	32	0.5			5	
	13:00	14:00	60				15	
	14:00	15:08	68				12	
Nov. 16	13:33	14:48	?	?			3	
							35	all plotted.

E. H. CLARKE AND 7, HIRAM, OHIO.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 15	17:30	18:00	30	0.5	11	7	18	2 observers to quadrant. E.S.T. used.

REV. R. G. HARBUTT, PENNEY FARMS, FLORIDA.

1929	Began	Ended	Total	F	Leonids	Others	Total	Notes
Nov. 27	"about 10"						9	"Andromedes"
28	"about 10"						2-3	"Andromedes"

RADIANTS BY STERLING BUNCH.

A.M.S. No.	1929		α °	δ °	Meteors	Wt.	Remarks
2094	Nov.	9.8	61	—16	4-6	Fair	
2095	Nov.	9.8	66	+14	6-9	Good	
2096	Nov.	9.8	151	+24	5	Fair	Leonids

RADIANTS BY B. C. DARLING.

2097	Oct.	8.6	12.5	+ 3	4	Poor	See 855; 1 Oct. 4
2098	Sept.	14.6	31	+72	3-5	Fair	2 on Sept. 11
2099	Oct.	16.77	85.5	+12.5	8	Good	Orionids
2100	Oct.	17.27	86	+ 2.5	3	Good	2 Oct. 16, 2 Oct. 17
2101	Oct.	17.77	88	+12	5	Good	Orionids
2102	Oct.	17.77	91	+21	3	Poor	1 other Oct. 16
2103	Sept.	30.16	340	+28	8	Good	1 on Sept. 27

RADIANT BY G. W. WHEELRIGHT AND 3.

2104	Nov.	15	151	+21	16-19	Good	Leonids

RADIANTS BY R. A. MCINTOSH.

2105	Aug.	31.57	11.0	—17.0	3	Good	1 meteor Sept. 1
2106	Sept.	1.66	44.8	—19.7	4	Good	2 meteors Aug. 31, 2 on Sept. 1
2107	Sept.	1.66	55.0	—11.5	5	Good	
2108	Oct.	5.61	41.4	— 2.3	6	Good	1 meteor Oct. 4, 1 on Oct. 6
2109	Oct.	5.61	59.1	—13.2	6	Good	2 meteors Oct. 6
2110	Oct.	5-6	67.6	+ 7.3	8	Good	
2111	Oct.	5-6	74.0	—52.5	4	Fair	1 meteor Oct. 4
2112	Oct.	5-6	98.0	+15.0	5	Fair	

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1929 December 17.

Observations of the 1929 Leonid Meteors.

BELOIT COLLEGE, BELOIT, WISCONSIN, by R. C. Huffer and class in astronomy.

		Leonids	Sporadic	Total
November 14	14:00-14:30	10	3	13
	14:30-15:00	9	2	11

Two fairly bright were plotted.

November 14 17:00-18:00 Two Leonids brighter than Jupiter observed by a student who made no attempt to keep count of the total number.

CENTRAL COLLEGE, PELLA, IOWA, by H. W. Pietenpol and Mrs. Pietenpol.

		Total
November 14	16:00-( )	"Practically nothing."
November 15	16:15-17:15	9

One reported as "quite bright" was plotted.

COLUMBIA COLLEGE, DUBUQUE, IOWA, by James J. Lynch, and Thomas L. Flood, under the direction of Father John A. Theobald.

November 14 16:00-17:45 7 meteors plotted near radiant region.
November 15 17:00-18:00 14 meteors plotted near radiant region.

TAMA, IOWA, by Mrs. W. G. McMartin.

		Leonids	Sporadic	Total
November 14	16:00-16:30	2	1	3
	16:30-17:00	1	2	3
	17:00-17:30	1		1

UNIVERSITY OF IOWA, IOWA CITY, IOWA, by C. C. Wylie and class in astronomy.

		Leonids	Sporadic	Unclassified	Total
November 14	16:20-17:20	10		34	44
	17:20-17:45	3		11	14

In the first hour six first magnitude meteors were recorded, and in the last twenty-five minutes two. The brightest was estimated about as bright as Procyon.

		Leonids	Sporadic	Unclassified	Total
November 15	16:30-17:00	7		5	12
	17:00-17:30	5	2	9	16
	17:30-17:56	13	5	2	20

In the first half hour, one meteor was recorded as first magnitude. In the second half hour three brighter than first were recorded, while in the last half hour one first magnitude and four brighter were recorded. Three of these last were comparable to Jupiter.

On November 14, P. C. Daniels, who has had considerable experience in meteor work, observed from 16:00 to 17:00, and again from 17:15 to 17:30, plotting a total of eight meteors on the chart including the radiant. On November 15, C. J. Lapp, an observer with experience, observed the radiant region from 16:22 to 17:52, plotting a total of fourteen.

As the members of the class in Astronomy were not very familiar with the constellations in the morning sky, most of them made no attempt to separate the Leonid meteors from the sporadic meteors, and consequently, a large number of unclassified meteors were reported, especially on November 14.

We hope that it will be found that some of the brighter meteors were plotted at more than one station, so that the real path through the atmosphere can be computed.

It is evident that in this section of the country the Leonid shower was better on November 15 than on November 14. At Central College, Professor Pietenpol reports that with the bright moon, and a sky not very clear, he saw "practically nothing" on November 14. He does not report how long he watched. On the following morning, as recorded, he observed nine meteors.

At Columbia College, Dubuque, several more meteors were plotted on the 15th than on the 14th. At the University of Iowa, more meteors were recorded on the 14th than on the 15th, but the majority of these were faint, and were recorded after the moon had practically disappeared. On the morning of the 15th, in spite of the fact that the moon was brighter and it was partly cloudy, nearly as many meteors were recorded, and many more bright ones.

University of Iowa, November 19, 1929. C. C. Wylie.

VARIABLE STARS.

Monthly Report of the American Association of Variable Star Observers for November, 1929.

We are pleased to welcome back to our active list of observers Rev. T. C. H. Bouton of St. Petersburg, Florida, who in spite of his more than seventy years finds time to keep close watch on many of our variables. Also we find the names of two new contributors in our list for this month, Messrs. Carl and McBride, students at Lehigh University working under the direction of Professor Barnes. More than a third of the observations here listed were contributed by our Italian contingent of five members, Sig. Lacchini's report of nearly 600 being the largest of any contributed by him for any one month since he joined the Association in 1911.

Secretary Olcott is spending the winter months in New Mexico and Arizona.

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

Sept. 0 = J.D. 2425855; Oct. 0 = J.D. 2425885; Nov. 0 = J.D. 2425916.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
S SCL			**R AND**			**RW AND**			**U AND**			**RU AND**			**T PER**		
001032			001838			004132			010940			013238			021258		
859	9.8	Ht	909	8.9	Ah	907	8.2	Ch	910	13.4	B	912	10.5	Al	910	9.0	Jo
869	8.8	Ht	910	8.4	Jo	913	8.7	L	911	12.3	L	921	10.6	Pt	911	8.7	BL
883	7.9	Ht	911	8.4	Ma	916	9.0	B	918	13.0	Br	923	10.7	Br	920	8.8	BL
X AND			911	8.8	Fd	916	8.9	Tf	**UZ AND**			**Y AND**			921	8.8	BL
001046			912	8.4	Ma	921	8.9	Pt	011041			013338			921	8.5	Pt
889	12.8	Lj	912	8.6	Ah	923	9.0	Br	889[	14.2	L	857	9.7	An	923	9.2	Jo
894[	12.8	Lj	913	8.3	Jo	**V AND**			907[	12.9	Ch	857	9.7	Be	927	9.0	BL
907	13.2	Ch	913	8.5	Br	004435			910[	14.0	B	871	9.7	Be	934	8.7	BL
913	13.5	B	913	8.3	B	907	13.2	Ch	912[	13.1	Al	871	9.7	An	**Z CEP**		
913	12.8	Br	920	8.8	Fd	918	12.6	Br	918[	14.2	Br	872	9.7	Gt	021281		
T CET			921	9.0	Wd	**X SCL**			**S PSC**			882	10.0	An	899[	14.4	L
001620			921	8.0	Jo	*004435*			011208			882	10.0	Gt	914[	13.0	L
884	6.3	An	921	8.6	Pt	910	13.4	B	889	14.4	L	888	10.0	L	926[	13.5	Br
894	6.4	L	923	9.0	Fd	**RR AND**			913	14.4	L	896	10.7	An	**o CET**		
910	6.4	Tf	924	9.1	Fd	004533			**S CAS**			896	10.7	Gt	*021403*		
914	6.6	Tf	825	8.8	Fd	889[	13.9	L	011272			899	10.6	L	882	6.9	Gt
914	6.5	L	931	8.3	Fd	907[	13.3	Ch	889[	13.6	L	908	11.2	Ch	882	6.9	An
916	6.8	Tf	**S TUC**			910	13.9	B	899[	13.6	L	910	11.4	B	888	6.9	L
T AND			*001862*			918[	14.2	Br	908[	13.7	B	911	11.9	L	889	7.0	Ah
001726			859	13.2	Ht	**RV CAS**			918[	13.6	Br	912	11.9	Al	893	7.3	Ch
910	12.8	B	883[	13.2	Ht	004746a			**U PSC**			921	11.9	Pt	893	7.6	Ma
918	12.9	Br	**S CET**			907[	13.9	Ch	011712			923	12.7	Br	896	7.3	L
T CAS			*001000*			908[	13.0	B	888	11.4	L	**X CAS**			900	7.4	Gt
001755			880	13.2	Gt	918[	13.9	Br	899	11.3	L	014958			900	7.5	An
889	7.5	L	880	13.2	An	**— CAS**			911	11.3	Ch	911	12.3	Bn	901	7.5	Ma
899	7.3	L	894	12.5	L	004746b			911	12.2	L	913	12.0	B	909	7.3	Ah
900	7.4	Gt	895	12.3	Ch	921	10.4	Pt	912	11.4	Al	**U PER**			910	8.0	Tf
900	7.7	An	896	12.5	Gt	**W CAS**			921	11.5	Pt	015254			910	7.5	Jo
904	7.4	Bx	896	12.5	An	004958			**RZ PER**			909	9.1	Ah	911	7.8	Ma
905	7.2	Ch	911	11.8	Ch	908	10.2	BL	012350			921	8.5	Pt	911	7.5	L
908	8.3	B	914	11.7	L	910	8.7	Jo	888	10.5	L	**S ARI**			911	7.4	BL
910	7.4	Jo	**T PHE**			911	9.2	BL	899	10.1	L	015912			912	7.3	Ah
911	7.4	L	*002546*			913	9.6	B	911	10.1	L	889	11.4	L	913	7.7	Jo
912	7.2	Mb	859	8.5	Ht	913	8.7	Jo	912	10.5	Al	896	11.3	L	914	7.7	Ch
912	7.2	Cr	869	9.5	Ht	920	9.6	BL	914	10.7	Ch	911	11.6	L	914	8.3	Tf
913	7.3	Jo	883	10.4	Ht	921	9.4	BL	923	9.9	Br	**R ARI**			915	7.8	Ah
921	7.5	Jo	**Y CEP**			921	8.8	Jo	**R PSC**			021024			920	7.5	BL
921	7.5	Pt	003179			921	9.0	Pt	012502			886	13.4	L	920	7.8	Jo
921	7.2	Mb	888	11.5	L	922	9.2	Lg	908	11.0	Ch	895	12.4	Ch	920	8.2	Ma
924	7.3	Mb	899	11.9	L	927	9.2	BL	909	10.6	Ah	895	13.0	L	921	7.8	Gt
R AND			907	12.8	Ch	931	9.2	BL	912	10.3	Ah	910	11.5	Sw	921	7.8	Jo
001838			913	12.6	Br	934	9.1	BL	912	11.1	Al	911	12.7	L	921	7.7	Pt
857	13.2	Be	914	12.7	L	**U TUC**			915	9.6	Ah	913	11.9	Jo	927	8.0	BL
857	13.3	An	918	13.2	Br	*005475*			921	9.6	Pt	921	11.9	Pt	931	7.9	BL
871	12.4	An	**U CAS**			859	11.8	Ht	**RU AND**			923	11.9	Br	934	8.0	BL
871	12.2	Be	004047			869	11.0	Ht	013238			923	11.7	Jo	**S PER**		
871	12.3	Gt	888	12.9	L	883	9.3	Ht	857	11.6	An	923	12.2	Fd	021558		
879	11.6	Ma	899	13.5	L	**Z CET**			871	11.7	An	925	11.3	Fd	878	10.0	Kl
882	11.5	Gt	907	13.6	Ch	*010102*			871	11.7	Gt	**W AND**			887	10.0	Kl
882	11.5	An	913[	14.0	B	890	12.6	L	882	11.3	Gt	021143a			908	10.2	BL
890	9.8	Ma	913[	13.9	Br	910	10.5	Ch	882	11.3	An	895	12.4	Ch	909	9.5	Ah
896	9.3	An	918[	13.9	Br	914	10.4	L	888	10.5	L	908	13.3	B	910	10.2	Jo
896	9.3	Gt	922[	13.5	Lg	921	10.0	Pt	896	11.1	An	921	14.0	Pt	911	10.0	BL
896	9.3	Be	**RW AND**			**U AND**			896	11.2	Gt	**T PER**			920	10.1	BL
901	9.0	Ma	004132			010940			899	10.7	L	021258			921	10.0	BL
904	8.8	Ch	888	8.2	L	888	13.7	L	908	10.8	Ch	908	8.8	BL	921	9.3	Pt
909	9.2	Gb	899	8.5	L	899	13.5	L	911	10.4	L	909	8.7	Ah	921	10.0	Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S PER	W PER	R TAU	R DOR	S AUR	T ORI
021558	024356	042209	*043562*	052034	*053025a*
927 9.8 BL	924 9.0 Mb	893 8.9 Ma	872 5.2 Ht	870 9.2 An	903 10.4 L
931 9.7 BL	R HOR	895 9.2 Ch	883 5.2 Ht	880 9.2 An	906 10.2 L
934 9.5 BL	*025050*	901 9.0 Ma	R CAE	880 9.1 Gt	908 10.4 L
R CET	859 12.4 Ht	912 9.4 Ma	*043738*	889 8.5 L	909 10.4 L
022000	883 12.8 Ht	922 9.6 Ma	872 8.4 Ht	900 8.5 L	910 9.9 Ma
888 9.6 L	T HOR	W TAU	883 9.2 Ht	900 9.0 Gt	911 10.3 L
893 10.6 Ch	*025751*	042215	R PIC	900 9.2 An	912 10.4 Pt
896 10.3 L	859 9.2 Ht	886 10.2 L	*044349*	920 9.0 BL	913 10.2 L
910 10.7 Jo	872 8.3 Ht	896 10.3 L	872 8.6 Ht	921 9.0 BL	914 10.0 L
911 11.0 L	883 7.9 Ht	911 9.5 L	883 9.0 Ht	921 8.2 Pt	915 10.0 L
913 10.9 Jo	U ARI	913 9.5 Jo	V TAU	922 8.0 Lg	920 11.4 Pt
921 11.8 Jo	030514	914 8.9 Tf	044617	927 9.0 BL	922 10.9 Lg
RR PER	886 12.3 Ch	921 8.9 Jo	894 11.1 Ch	934 8.3 BL	923 11.4 Pt
022150	886 12.3 L	921 9.5 Pt	921 9.4 Pt	W AUR	925 10.5 Pt
886 10.0 L	896 12.6 L	922 9.1 Lg	R ORI	052036	925 9.8 Ma
896 10.6 L	911 13.1 L	926 9.2 Jo	045307	870 9.7 An	926 10.5 Pt
914 11.2 L	X CET	S TAU	887 9.8 L	880 9.5 An	AN ORI
921 11.6 Pt	*031401*	042309	895 10.0 Ch	880 9.4 Gt	*053005f*
926 11.4 Br	870 11.9 An	901 10.6 Ma	898 9.5 L	887 9.5 L	886 11.8 L
U CET	880 11.3 Gt	912 13.0 Ma	R LEP	895 10.0 Ch	887 11.5 L
022813	880 11.4 An	922 12.0 Ma	*045511*	898 9.5 L	888 11.5 L
921 9.8 Pt	888 10.8 L	T CAM	889 6.9 L	900 9.2 Gt	889 11.6 L
RR CEP	896 9.7 L	043065	893 7.1 Ma	900 9.4 An	890 11.7 L
022980	901 9.8 Gt	857 8.5 An	900 6.7 L	910 9.5 Jo	893 11.6 L
889 14.5 L	901 9.8 An	870 8.8 An	910 5.8 Tf	913 9.7 Jo	894 11.6 L
900 14.0 L	911 9.2 Ch	880 9.9 An	911 6.0 Ch	921 10.0 Jo	895 11.7 L
915 14.3 L	911 9.1 L	880 8.8 Gt	912 7.1 Ma	921 9.9 Pt	897 11.7 L
926 14.0 Br	921 8.5 Pt	880 8.7 Be	921 6.0 Pt	922 9.8 Lg	898 11.7 L
R TRI	Y PER	889 8.7 L	922 6.7 Ma	922 10.2 Sf	899 11.6 L
023133	032043	899 9.1 An	V ORI	S ORI	900 11.7 L
889 11.4 Ah	895 9.8 Ch	899 9.1 Gt	050003	*052304*	901 11.6 L
893 11.5 Ma	908 10.1 BL	900 8.7 L	889 14.3 L	893 10.4 Ma	902 11.6 L
901 10.4 Ma	911 9.6 BL	911 9.7 Sw	899 14.1 L	912 10.6 Ma	903 11.6 L
903 10.3 Bx	912 9.2 Mb	921 9.4 BL	921 13.5 Pt	921 11.2 Pt	906 11.6 L
909 10.5 Ah	912 9.2 Cr	921 9.7 Pt	T LEP	925 10.6 Ma	908 11.6 L
910 10.2 Jo	920 9.8 BL	927 9.5 BL	*050025*	T ORI	909 11.5 L
911 9.7 Ma	921 9.9 BL	931 9.8 BL	921 10.7 Pt	*053005a*	911 11.6 L
911 9.9 Ch	921 10.0 Pt	934 10.0 BL	S PIC	884 11.6 An	913 11.6 L
911 10.6 Sf	924 9.6 Mb	RX TAU	*050848*	886 11.8 L	914 11.6 L
912 9.4 Ma	927 9.8 BL	043208	872 11.0 Ht	887 11.6 L	915 11.6 L
912 10.5 Ah	931 9.7 BL	887 9.2 L	883 9.7 Ht	888 11.6 L	S CAM
912 9.4 Mb	934 9.5 BL	895 9.4 Ch	R AUR	889 11.6 L	053068
913 9.7 Jo	R PER	898 9.3 L	050953	890 11.5 L	911 9.6 Ch
915 10.0 Ah	032335	921 10.5 Pt	894 12.8 Ch	890 10.4 An	921 8.8 Pt
921 9.3 Pt	886 12.8 L	R RET	921 13.2 Pt	893 11.0 Ma	RR TAU
921 9.5 Jo	895 13.5 Ch	*043263*	T PIC	893 10.3 L	053326
921 9.6 Sf	896 13.3 L	859 8.0 Ht	*051247*	894 11.1 L	884 13.1 An
924 9.4 Mb	T FOR	872 9.5 Ht	872 9.5 Ht	895 11.4 L	886 12.6 L
927 9.2 Sf	*032528*	883 10.4 Ht	883 11.0 Ht	896 11.0 Gt	887 12.4 L
W PER	888 8.5 L	X CAM	NOV TAU	897 10.9 Pt	888 12.9 L
024356	896 8.7 L	043274	051316	897 11.0 L	889 12.5 L
903 9.0 Bx	913 8.9 L	889 13.2 L	887 14.0 L	898 10.7 L	890 12.7 L
910 9.3 Jo	U ERI	900 13.2 L	T COL	899 10.8 L	893 13.1 L
912 9.1 Mb	*034625*	914 12.7 L	*051533*	899 10.7 Pt	894 13.2 L
912 9.2 Cr	889 11.9 L	921 12.0 Pt	872 8.4 Ht	900 10.7 L	895 13.1 L
913 9.2 Jo	900 12.3 L	R DOR	883 8.4 Ht	901 10.1 L	896 13.0 L
921 9.3 Pt		*043562*		902 10.2 L	897 13.0 L
923 9.6 Jo		859 5.2 Ht		902 10.2 An	898 13.0 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RR TAU
053326
899 12.9 L
900 13.1 L
901 13.3 L
902 13.3 L
903 13.2 L
909 12.6 L
911 12.2 L
913 12.3 L
914 12.7 L
915 12.3 L

RU AUR
053337
921[12.0 Pt
924[12.4 Mb

U AUR
053531
887 13.5 L
895[12.8 Ch
899 13.7 L

Y TAU
053920
919 7.3 K1

SU TAU
054319
870 9.2 An
872 9.4 An
872 9.6 Gt
882 9.3 Gt
882 9.3 An
884 9.4 An
885 9.5 An
885 9.5 Gt
886 9.5 L
887 9.6 L
888 9.6 L
889 9.5 L
890 9.6 L
893 9.6 L
894 9.5 L
895 9.6 L
895 9.8 Ch
896 9.5 An
896 9.6 Gt
896 9.6 L
897 9.5 L
897 9.6 Pt
898 9.6 Pt
898 9.6 L
899 9.6 L
899 9.6 Pt
900 9.5 Gt
900 9.5 An
900 9.6 L
901 9.6 L
901 9.5 Gt
901 9.5 An
902 9.4 An
902 9.5 L

SU TAU
054319
903 9.6 L
906 9.5 L
908 9.6 L
910 9.4 L
910 9.6 Pt
911 9.5 L
911 9.8 Ch
912 9.6 Pt
913 9.5 L
915 9.6 L
920 9.6 Pt
921 9.6 Pt
923 9.7 Pt
925 9.6 Pt
926 9.6 Pt

Z TAU
054615a
890 13.8 L
900 13.5 L
915 13.3 L

RU TAU
054615c
890 12.2 L
900 12.3 L
915 12.3 L

α ORI
054907
886 0.8 L
894 0.8 L
901 0.7 L
915 0.8 L

U ORI
054920a
889 8.5 Fd
895 7.2 Ch
909 6.9 Ah
910 7.6 Fd
911 7.5 Fd
912 7.5 Fd
912 6.9 Ah
914 6.9 Ah
915 6.9 Ah
920 7.0 Fd
921 6.4 Pt
924 7.0 Fd
925 7.1 Fd
931 6.9 Fd

V CAM
054974
890[14.9 L

Z AUR
055353
897 10.1 Pt
898 10.0 Pt
899 10.2 Pt
910 9.9 Pt
911 10.0 Pt
912 10.0 Pt

Z AUR
055353
918 9.9 Pt
920 10.2 Pt
921 10.1 Pt
923 10.1 Pt
925 10.0 Pt
926 10.0 Pt

R OCT
055586
859 10.9 Ht
860 11.0 En
876 10.9 Ht
883 11.5 Ht

X AUR
060450
887 8.9 L
889 9.2 Lj
894 8.6 Ch
898 9.1 Lj
898 8.5 L
905 8.7 Lj
909 8.8 Lj
915 9.2 Lj
915 8.8 L
921 8.9 Pt

V AUR
061647
887 9.8 L
898 10.4 L
915 11.4 L

V MON
061702
923 7.7 Pt

AG AUR
062047
887 9.2 L
898 9.6 L
908 9.8 L

R MON
063308
923 11.5 Pt

NOV PIC
063462
872 8.1 Ht
883 8.1 Ht

S LYN
063558
887 13.5 L
898 13.2 L
914 12.1 Ch
915 12.6 L
921 11.8 Pt

X GEM
064030
919 12.8 Bn
924 12.8 Bn

Y MON
065111
890 9.5 L

Y MON
065111
900 9.6 L
914 10.2 Ch
915 10.0 L
923 10.5 Pt

X MON
065208
890 9.5 L
900 9.1 L
915 8.0 L

R LYN
065355
887 8.4 L
898 8.6 L
909 9.1 Ah
912 9.1 Ah
914 9.0 Ch
915 9.0 L

V CMI
070109
887 8.3 L
898 8.6 L
914 9.5 Ch
915 8.9 L

R GEM
070122a
899 9.5 Pt
912 7.8 Ah
914 7.6 Ah
914 7.8 Ch
915 7.5 Ah

Z GEM
070122b
899 12.3 Pt

TW GEM
070122c
899 7.8 Pt

R CMI
070310
887 8.2 L
898 8.2 L
914 8.8 Ch
915 8.5 L

R VOL
070772
883 11.5 Ht

RR MON
071201
894 14.9 L
914 15.0 L

V GEM
071713
887 8.4 L
898 8.6 L
915 9.2 L

S CMI
072708
914 7.8 Ch
924 7.9 Fd
925 7.9 Fd
931 7.7 Fd

T CMI
072811
886 11.2 L
898 10.8 L
899 11.2 Pt
915 10.5 L

S VOL
073173
883[12.8 Ht

U CMI
073508
887 9.0 L
898 8.6 L
899 8.7 Pt
914 8.5 Ch
915 8.3 L

S GEM
073723
898[12.4 Ch

T GEM
074323
898[12.4 Ch
899 12.4 Ch

U PUP
075612
890 12.0 L
900 12.1 L
914 12.4 L

R CNC
081112
898 11.1 Ch
899 11.1 Pt
914 11.3 Ch
915 11.4 Ch
915 11.5 Ah

RR HYA
082405
899 8.3 Pt

R CHA
082476
859[12.4 Ht
883[12.4 Ht

U CNC
083019
890[13.9 L
901 14.2 L
914 14.5 L

S HYA
084803
898 12.1 Ch
899 12.3 Pt

T HYA
085008
890 10.1 L
898 11.2 Ch
899 11.3 Pt
901 11.1 L
914 11.9 L

T CNC
085120
899 9.2 Pt

V UMA
090151
890 10.1 L
901 10.2 L
915 10.3 L

W CNC
090425
887 11.7 L
898 12.6 L
914 12.4 L

RX UMA
090567
890 11.1 L
901 11.3 L
914 11.3 L

Y DRA
093178
892 11.4 L
901 9.9 L
914 9.3 L

R LMI
093934
884 10.2 Ch
899 10.5 Pt

RR HYA
094023
894[13.0 L
911 14.0 L

R LEO
094211
884 7.2 Ch
899 6.8 Pt
925 8.4 Fd
931 7.5 Fd

U HYA
103212
901 4.8 L
911 5.0 L

R UMA
103769
898 12.4 Ch
899 12.6 Pt
909 11.0 Ah
912 11.0 Ah
913 11.7 Jo
914 11.0 Ah
921 11.2 Jo
926 10.5 Jo

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V HYA	T UMA	R HYA	S BOO	RS LIB	R CRB
104620	123160	*132422*	141954	*151822*	154428
903 7.1 L	920 9.6 Fd	858 7.6 En	868 13.3 Gt	858 9.5 En	882 6.2 Gt
915 6.7 L	923 9 5 Fd	S VIR	868 13.3 An	859 9.8 Ht	884 5.9 An
W LEO	924 9.7 Fd	*132705*	878 13.0 An	869 10.2 Ht	885 5.8 Ch
104814	925 9.5 Fd	858 9.1 En	883 12.6 Gt	876 10.4 Ht	885 6.3 Be
887 11.2 L	R VIR	RV CEN	888 13.0 L	883 10 9 Ht	886 6.2 Lj
898 11.8 L	123307	*133155*	899 12.9 L	R NOR	887 6.2 Be
911 12.1 L	923 10.5 Pt	858 7.8 En	900 12.4 Gt	*152840*	887 6.7 Kl
S LEO	RS UMA	T UMI	900 12.1 An	858 8.0 En	887 6.0 L
110506	123459	133273	911 12.1 Pt	859 8.0 Ht	888 6.0 L
901 12.5 L	889[12.0 Fd	888 11.8 L	913 11.8 Jo	869 7.5 Ht	888 6.1 Be
915 12.0 L	893[12.6 Ma	904 12.6 L	915 11.5L	876 7.2 Ht	889 6.2 Lj
RY CAR	899 13.6 Pt	911 11.4 Fd	921 11.5 Jo	883 7.0 Ht	889 6.1 Ah
111561	925[12.0 Fd	T CEN	926 11 2 Jo	S UMI	890 6.0 L
859[13.1 Ht	S UMA	*133633*	RS VIR	153378	890 6.2 Lj
RS CEN	123961	858 6.4 En	142205	889 8.5 Li	894 6.1 L
111661	862 7.8 Gt	859 5.9 Ht	887 8.8 L	889 8.2 Ah	894 6.2 Lj
859 8.6 Ht	871 7.9 Gt	869 6.2 Ht	V BOO	894 8.5 Lj	894 6.1 Be
AD CEN	871 7.7 An	876 6.5 Ht	142539	898 8.5 Li	897 6.1 Pt
114858	872 8.6 Kl	RT CEN	868 10.5 Gt	900 8.6 Lj	898 6.0 Be
859 9.5 Ht	879 8.3 Gt	*134236*	868 10.4 An	901 8.3 Ah	898 6.2 Lj
869 9.3 Ht	880 8.6 Kl	858[12.4 En	878 10.3 An	905 8.6 Li	899 6.2 Lj
876 9.5 Ht	883 8.8 Kl	859[13.0 Ht	883 10.4 Gt	906 8.4 Ah	899 6.1 Pt
W CEN	887 8.8 Kl	869[12.4 Ht	900 9.4 Gt	907 8.6 Lj	899 6.0 L
115058	888 8 9 Gt	R CVN	900 9.2 An	909 8.3 Ah	900 6.0 L
857 9.0 En	889 9.4 Li	134440	911 9.2 Pt	910 8 6 Ch	900 6.2 Lj
859 8.6 Ht	889 8.6 Fd	889 11.2 Ah	913 8.5 Jo	910 8.0 Jo	900 6.1 Gt
869 8.8 Ht	889 8.7 Ah	923 11.9 Pt	921 8.4 Jo	911 8.6 Pt	900 6.1 Pt
876 9.0 Ht	892 9.1 Kl	RX CEN	926 8.3 Jo	912 8.5 Ah	901 6.1 Pt
SS VIR	893 8.6 Ma	*134536*	R BOO	914 8.7 Lj	901 6.0 L
122001	894 9.3 Lj	858[13.1 En	143227	915 8.7 Li	901 6.2 Lj
911 7.1 L	898 9.3 Li	T APS	889 12.1 Lj	915 8.5 Ah	901 6.0 Ah
T CVN	899 9.3 Lj	*134677*	894 11.9 Li	921 8.2 Jo	902 6.1 Pt
122532	899 9.0 Pt	858[12.7 En	898 11.5 Li	921 8.6 Sf	904 6.1 Pt
899 9.5 Pt	902 9.1 Gt	859[13.2 Ht	907 10.6 Li	923 8.5 Jo	906 6.0 L
Y VIR	905 9.3 Lj	876[12.7 Ht	914 10 0 Lj	927 8.8 Sf	906 6 0 Ah
122803	906 9.1 Ah	883 12.9 Ht	S LEP	T NOR	907 6.2 Lj
860 7.8 En	909 9.4 Ah	RU HYA	*144646a*	*153654*	908 6.1 Ch
T UMA	911 9.3 Fd	*140528*	858[12.1 En	858 11.8 En.	908 6.3 Wd
123160	912 9.6 Fd	857 9.8 En	Y LUP	859 11.4 Ht	909 6.1 Be
878 8.5 Kl	912 10.0 Kl	859 9.7 Ht	*145254*	869 10.5 Ht	909 6.0 Gb
879 8.4 Ma	912 9.5 Ah	869 8.9 Ht	858 11.3 En	876 9.4 Ht	909 6.0 Ah
880 8.5 Kl	914 9.7 Ah	R CEN	S APS	883 8.2 Ht	910 6.0 Jo
883 8.5 Kl	914 9.5 Lj	*140959*	*145971*	R CRB	910 6.3 Pt
887 8.3 Kl	915 9.7 Ah	858 7.3 En	858 10.9 En	154428	911 6.2 Pt
889 8.4 Fd	919 10.3 Kl	859 6.9 Ht	859 11.2 Ht	856 6.0 Be	912 6.2 Pt
889 8.6 Ah	920 10.3 Fd	869 6.2 Ht	869 11.2 Ht	857 6.2 An	912 5.9 Ah
892 8.3 Kl	921 9.4 Wd	876 5.9 Ht	876 11.2 Ht	859 6.0 Be	912 6.0 L
893 8.4 Ma	923 10.5 Fd	883 5.7 Ht	883 11.2 Ht	862 6.1 Gt	912 6.3 Kl
899 8.6 Pt	924 10.4 Fd	U UMI	S SER	864 6.0 Be	913 5.8 Jo
906 8.7 Ah	925 10.0 Fd	141567	151714	868 6.0 Gt	914 6.2 Lj
909 8.8 Ah	U OCT	889 10.0 Lj	870 6.0 Be	914 6.1 Ch	
911 9.5 Fd	*131283*	894 10.2 Lj	888 9.4 L	871 6.1 Gt	916 6.0 L
912 9.0 Ah	859 8.6 Ht	898 10.2 Lj	899 9.8 L	876 6.3 Gt	918 6.1 Pt
912 8.9 Kl	860 8.5 En	907 10 5 Lj	S CRB	876 5.9 An	921 6.1 Pt
912 9.5 Fd	869 8.8 Ht	909 10.9 Ah	151731	876 6.0 Be	921 5.8 Jo
914 9.1 Ah	876 9.2 Ht	911 10.1 Pt	908 7.8 Ch	878 6.1 Kl	921 6.1 Wd
915 9.1 Ah	883 9.4 Ht	914 10.7 Lj	911 8.6 Pt	879 6.2 Gt	922 6.1 Pt
919 9.1 Kl				882 6.2 Be	924 6.1 Pt

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CrB	U Ser	U Her	S Dra	R Oph	RS Oph
154428	160210	162119	164055	*170215*	174406
925 6.1 Pt	889 8.5 An	883 9.4 Kl	883 9.0 Gt	907 11.6 Ch	910 11.1 Pt
926 5.8 Jo	889 8.4 Be	887 9.2 Kl	889 9.1 Gt	910 11.5 Pt	U Ara
927 6.1 Pt	889 8.4 Gt	889 9.0 Ah	889 9.1 An	RT Her	*174551*
X CrB	897 8.4 An	901 7.3 Ah	889 9.0 Be	170627	859 9.3 Ht
154536	SX Her	906 7.2 Ah	900 8.9 An	909[13.4 Ch	860 8.6 En
887 10.2 L	160325	908 7.5 Ch	900 8.9 Gt	RW Sco	869 8.5 Ht
904 11.7 L	888 8.3 L	909 7.1 Ah	RR Oph	*170833*	883 8.6 Ht
908 11.3 Ch	897 8.0 Pt	910 7.4 Pt	*164310*	860 10.3 En	RT Oph
911 10.9 Pt	899 8.0 Pt	910 7.1 Jo	860 11.5 En	Z Oph	175111
916 12.2 L	901 7.8 L	912 7.4 Kl	889 10.2 L	171401	909[13.4 Ch
R Ser	902 8.0 Pt	912 7.2 Ah	901 8.6 L	889 8.3 Ah	T Dra
154615	904 8.1 Pt	921 7.3 Sf	S Her	901 8.2 Ah	175458a
911 9.9 Pt	906 7.9 L	921 7.0 Jo	164715	909 8.4 Ah	909 12.3 Ch
V CrB	910 7.9 Pt	926 7.0 Jo	889 8.2 Ah	910 8.0 Pt	UY Dra
154639	911 8.2 Pt	SS Her	901 8.6 Ah	912 8.6 Ah	175458b
908 7.8 BL	912 8.3 Pt	162807	906 9.0 Ah	RS Her	909 10.8 Ch
911 8.0 Pt	918 8.4 Pt	858 12.2 An	909 8.8 Ch	171723	RY Her
912 7.7 Md	921 8.0 Pt	858 12.2 Be	909 8.9 Ah	910 12.4 Pt	175519
916 8.3 BL	922 8.0 Pt	871 11.0 An	910 9.1 Pt	918 12.2 Md	888 12.9 L
919 7.9 Md	924 8.2 Pt	882 10.0 An	912 8.9 Ah	935[12.2 Md	904 11.6 L
921 7.8 BL	925 8.2 Pt	882 9.9 Gt	RS Sco	S Oct	909 11.2 Ch
923 7.9 Md	927 8.2 Pt	882 9.9 Gt	*161841*	*172486*	910 11.0 Pt
927 8.0 BL	RU Her	887 9.5 L	858 7.0 En	859[13.0 Ht	912 11.0 Md
931 7.9 BL	160625a	901 9.7 L	859 6.9 Ht	860[12.1 En	914 10.7 L
934 7.8 BL	858 13.1 An	910 10.6 Pt	869 7.4 Ht	876[13.0 Ht	919 10.5 Md
935 8.5 Md	858 13.1 Be	S Oph	876 7.7 Ht	883[13.0 Ht	936 9.4 Md
R Lup	879 13.4 An	*162816*	883 7.7 Ht	RU Oph	V Dra
154736	889 13.3 L	889 9.7 L	RR Sco	172809	175654
858[12.0 En	900 12.6 An	901 8.9 L	*165030a*	857 9.2 An	888 13.4 L
Z CrB	906 12.0 L	W Her	857 9.2 Be	909 13.9 L	
155229	909 11.7 Ch	163137	860 7.0 En	871 9.2 An	936[12.2 Md
887[13.4 L	911 11.7 Pt	899[10.5 Fd	869 5.7 Ht	871 9.3 Be	R Pav
908[12.4 Ch	R Sco	908[12.4 Ch	876 5.7 Ht	881 9.6 Gt	*180363*
RZ Sco	*161122a*	910 14.0 Pt	883 5.7 Ht	881 9.5 An	859 12.0 Ht
155823	858 12.0 En	R Dra	RV Her	888 9.5 L	860 11.8 En
859 9.4 Ht	859 11.9 Ht	163266	165631	889 9.6 L	869 11.6 Ht
860 9.5 En	869 11.2 Ht	879 9.0 Ma	871 10.6 Be	897 9.6 An	876 11.0 Ht
869 10.2 Ht	876 11.1 Ht	889 9.9 Fd	871 10.5 An	899 9.8 L	883 10.3 Ht
876 10.5 Ht	883 11.0 Ht	889 10.2 Lj	880 11.5 An	906 10.7 Fe	T Her
883 11.0 Ht	S Sco	890 10.4 Ma	880 11.6 Gt	909 10.8 Ch	180531
Z Sco	*161122b*	894 10.7 Lj	888 11.9 L	910 10.8 Fe	871 8.7 Be
160021	858[11.9 En	898 10.8 Lj	899 12.2 L	910 10.0 Pt	871 8.9 Gt
858 9.8 En	876[12.6 Ht	907 11.0 Lj	899 12.4 An	916 10.9 L	871 9.0 An
859 10.1 Ht	883[13.2 Ht	909 10.9 Ah	909 12.8 Ch	RT Ser	880 9.5 An
861 9.8 An	W CrB	909 11.2 Ch	910 13.5 Pt	*173411*	880 9.5 Gt
869 10.1 Ht	161138	910 11.0 Pt	914 12.7 L	906 12.5 L	888 10.6 L
876 10.0 Ht	912[11.8 Md	910 11.5 Jo	RT Sco	RU Sco	897 11.3 An
883 9.7 Ht	W Oph	911 11.5 Fd	*165636*	*173543*	899 11.6 L
U Ser	*161607*	912 11.7 Fd	860 10.0 En	860 9.3 En	909 12.3 Ch
160210	881[12.7 An	913 12.0 Jo	— Dra	SV Sco	910 12.2 Pt
861 10.0 Be	882[12.7 Gt	914 11.6 Lj	165752	*174135*	911 11.0 Bc
861 10.1 An	V Oph	920 11.3 Ma	888 9.6 L	860[12.2 En	914 12.9 L
871 9.6 Be	*162112*	924[12.0 Fd	899 9.5 L	W Pav	W Dra
871 9.4 An	889 9.3 L	S Dra	914 10.1 L	*174162*	180565
873 9.4 Gt	901 8.4 L	164055	R Oph	860[12.3 En	888 9.9 L
880 8.7 An	U Her	868 9.2 Gt	*170215*	876[13.0 Ht	904 11.2 L
880 8.7 Be	162119	868 9.2 An	888 10.5 L	883[13.0 Ht	909 11.7 Ch
880 8.7 Gt	878 9.5 Kl	879 9.2 An	906 11.0 L		914 12.0 L

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
W DRA	RZ HER	R SCT	R SCT	Z LYR	RS LYR
180565	183225	*184205*	*184205*	185634	190933a
918 12.0 Md	889 13.9 L	880 5.6 Gt	910 5.0 Bc	888 11.4 L	894 13.8 L
936[12.0 Md	909[14.1 L	880 5.5 Be	910 4.9 Tf	895 11.0 Ch	909 14.0 L
X DRA	918[11.9 Md	881 5.6 Gt	910 5.7 Jo	909 10.1 L	RU LYR
180666	936[11.9 Md	882 5.6 Gt	910 5.3 Pt	910 10.5 Pt	190941
888 10.7 L	X OPH	882 5.4 Be	911 5.2 Pt	916 10.5 B	894 14.3 L
904 11.5 L	183308	883 5.3 Be	912 5.3 Pt	SU SGR	909 14.2 L
914 11.5 L	857 6.4 Be	883 5.5 Gt	912 5.0 Bc	*185722*	U DRA
918 11.5 Md	857 6.4 An	884 5.5 Gt	913 5.6 Jo	859 8.2 Ht	190967
936 12.0 Md	871 6.8 An	884 5.5 An	913 5.4 Ch	872 8.1 Ht	869 12.3 An
W LYR	871 6.7 Be	885 5.4 Gt	914 4.9 Lj	876 8.3 Ht	873 12.0 An
181136	881 7.1 Gt	885 5.4 Be	914 5.1 Tf	883 8.3 Ht	873 12.0 Gt
857 11.0 An	881 7.0 Gt	887 5.2 Be	916 5.1 Tf	RT LYR	884 12.0 An
868 12.2 Gt	881 7.0 An	888 5.3 Gt	916 5.7 Bc	185737	895 11.3 Ch
868 12.2 An	888 7.1 L	889 5.2 Gt	916 5.6 L	894[13.0 Ch	895 11.4 L
878 12.2 An	897 7.8 An	889 5.6 Lj	918 5.4 Pt	909 14.4 L	897 11.5 An
883 12.6 Gt	902 7.5 L	889 5.3 Bc	921 5.6 Pt	R AQL	908 10.3 Ch
889 11.9 L	910 7.7 Jo	890 5.2 Bc	921 5.4 Gb	190108	909 10.3 L
889 12.2 Gt	910 8.0 Pt	890 5.6 Lj	921 5.8 Wd	889 11.6 An	910 10.4 Pt
889 12.1 An	912 8.0 Al	890 5.0 L	922 5.4 Pt	894 11.5 Ch	W AQL
889 12.1 Be	913 7.9 Jo	891 5.2 Bc	923 5.8 Fd	909 11.7 Ah	*191007*
900 11.8 An	914 7.7 L	893 5.2 Bc	923 5.6 Jo	909 11.5 B	910 9.9 Pt
900 12.1 Gt	921 8.3 Jo	893 4.8 Ma	924 5.6 Fd	910 11.6 Pt	T SGR
906 10.2 L	923 8.5 B	894 5.0 Be	924 5.5 Pt	912 11.6 Ah	*191017*
910 9.8 Jo	RY LYR	894 5.0 Lj	925 5.6 Pt	V LYR	885 10.0 Ch
910 10.0 Pt	184134	894 5.0 Ch	927 5.7 Pt	190529a	894 9.3 L
911 10.0 Bc	889 13.3 L	894 5.1 L	931 5.6 Wd	890 12.7 L	904 9.6 L
912 9.8 Al	909 14.3 L	896 5.0 Be	RW LYR	897[12.3 Ch	910 9.0 Pt
913 9.5 Jo	R SCT	896 5.1 Gt	184243	909[14.0 L	914 9.0 L
916 9.6 B	*184205*	897 5.0 Pt	910 11.8 Pt	913[12.3 Md	R SGR
921 9.1 Sf	856 7.6 Be	898 4.9 Lj	916 13.2 B	918[12.3 Md	*191019*
921 9.2 Jo	856 7.6 An	898 5.0 Bc	Nov AQL	936[12.3 Md	861 8.8 En
926 8.8 Al	857 7.4 An	899 4.9 Lj	184300	RX SGR	885 7.8 Ch
927 8.9 Sf	857 7.4 An	899 5.0 Gt	893 10.6 Ma	*190818*	894 7.9 L
RV SGR	857 7.2 Be	899 4.9 Pt	894 10.6 Ch	861 12.0 En	904 7.3 L
182133	858 7.1 Be	899 5.5 Fd	904 11.7 Pt	906 12.7 L	909 7.4 Ch
860 9.8 En	858 7.2 An	900 5.0 Bc	910 11.6 Pt	RW SGR	910 7.6 Pt
SV HER	859 7.3 An	900 5.0 Gt	921 11.7 Pt	*190819a*	914 7.7 L
182224	861 7.2 An	900 5.0 Pt	RX LYR	861 9.3 En	RY SGR
871 11.7 Be	861 7.1 Be	900 5.0 An	185032	894 9.3 L	*191033*
871 11.5 Gt	862 7.1 Gt	901 5.0 Pt	894[13.0 Ch	906 9.6 L	859 6.6 Be
871 11.9 An	864 7.2 An	901 5.0 Bc	909[14.5 L	910 9.3 Pt	859 6.2 Ht
880 12.5 An	867 7.0 Gt	901 4.9 Be	936[12.5 Md	BH SGR	861 6.5 En
880 12.5 Gt	867 6.9 An	901 4.9 Lj	S CRA	*190810b*	861 6.6 Be
889 13.1 L	869 6.0 An	902 5.2 Lg	*185437a*	906 13.0 L	861 6.2 An
891 12.6 Gt	869 6.2 Gt	902 4.9 Gt	861 12.0 En	TY AQL	869 6.5 Ht
897 12.9 An	871 6.2 Gt	902 4.9 Pt	ST SGR	*190007*	872 6.8 An
906 13.7 L	871 6.0 An	902 5.1 L	*185512a*	910 10.4 Pt	872 6.8 Gt
910 13.7 Pt	872 6.0 An	904 5.0 Pt	888 11.0 L	S LYR	872 6.8 Be
T SER	872 6.1 Gt	904 5.2 Lg	904 11.8 L	190925	876 6.2 Ht
182306	872 6.1 Be	907 4.9 Lj	914 12.2 L	893 12.3 L	883 6.5 Ht
910 12.0 Pt	873 6.0 Gt	908 5.2 Lg	R CRA	896 12.9 Ch	884 6.2 Gt
SV DRA	873 5.9 An	908 5.2 Wd	*185537a*	909 13.5 L	884 6.2 An
183149	876 6.0 An	908 5.0 Ch	861 11.7 En	916 13.3 B	885 6.4 Ch
879[11.9 Ma	876 6.0 Gt	909 5.0 L	T CRA	X LYR	894 6.4 L
889 13.0 L	876 5.7 Be	909 5.0 Be	*185537b*	190926	897 6.5 L
909 13.6 L	877 5.8 An	909 5.0 Bc	861[12.5 En	910 8.9 Pt	897 6.3 Pt
920[13.2 Ma	879 5.8 An	909 5.8 Gb			899 6.6 Pt
	879 5.8 Gt	909 5.3 Mg			899 6.5 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RY SGR
191033
901 6.6 L
902 6.6 Pt
904 6.7 Pt
909 6.9 L
910 6.7 Pt
911 6.5 Pt
912 6.6 Pt
921 6.6 Pt
922 6.4 Pt
924 6.3 Pt
925 6.3 Pt
927 6.4 Pt

TY SGR
191124
861[12.4 En
S SGR
191310a
861[12.2 En
908[12.9 Ch

TZ CYG
191350
910 10.7 Pt

U LYR
191637
910 11.8 Pt

AF CYG
192745
909 7.7 Ah
912 7.6 Ah
914 7.4 Ah
915 7.2 Ah

TY CYG
192928
895 13.2 Ch
895 13.8 L
910 13.8 L

RT AQL
193311
894 8.6 L
895 8.6 Ch
909 9.4 L
909 10.1 Ah
910 9.9 Pt
912 10.2 Ah
916 10.1 B

R CYG
193449
889 10.8 Ah
889 10.8 Fd
899 11.6 Fd
905 10.9 Wd
907 11.4 Ch
908 11.9 Al
910 11.9 Sw
910 10.9 Pt
910 11.3 Jo
911 11.8 Fd
913 11.5 Jo

R CYG
193449
920 11.3 Fd
921 11.0 Wd
923 12.3 Fd
923 12.0 Jo
924 12.5 Fd
925 12.1 Fd
926 12.3 Al

RV AQL
193509
894 12.9 L
909 13.5 L

T PAV
193972
859 13.1 Ht
861 13.2 En
876 13.3 Ht
883 13.4 Ht

RT CYG
194048
899 9.4 Fd
908 8.6 Al
909 8.8 Ah
910 8.5 Sw
910 8.6 Pt
911 8.9 Fd
912 8.5 Ah
913 7.2 Jo
914 8.5 Ah
915 8.4 Ah
920 7.7 Fd
923 7.5 Fd
923 7.2 Jo
924 8.0 Fd
925 7.6 Fd
926 7.3 Jo
926 7.0 Al

TU CYG
194348
886 9.3 Ch
890 9.1 Ma
893 9.5 Ch
895 9.2 L
910 9.3 L
910 9.6 Pt
920 9.7 Ma
934 10.2 Ma

X AQL
194604
894 9.8 L
909 9.5 L
909 9.6 B
910 9.8 Tf
910 9.6 Pt
912 9.5 Ch
914 9.8 Tf
921 10.0 Sf
927 9.9 Sf

χ CYG
194632
861 7.1 An
872 7.5 An
872 7.4 Gt
879 7.8 Ma
882 7.7 Gt
882 7.7 An
889 8.8 Gt
889 8.3 Ah
890 8.2 Ma
899 8.9 An
899 8.6 Be
901 9.2 Ah
905 9.3 Wd
905 9.6 Sw
907 9.0 Ch
909 9.3 Ah
910 9.5 Pt
912 9.6 Ah
914 9.6 Ah
920 9.6 Ma
921 10.5 Wd
934 10.1 Ma

S PAV
194650
861 7.7 En

RR SGR
194929
861 10.6 En

RU SGR
195142
859 8.0 Ht
872 9.1 Ht
883 10.1 Ht

RR AQL
195202
894 10.1 L
909 9.2 L
909 9.3 B
909 9.2 Mg
910 9.3 Pt
912 9.6 Ch

RS AQL
195308
894 14.3 L
912 14.2 L
916[14.0 B

NOV CYG
195553
879[11.6 Ma
890[11.6 Ma
910[12.2 Pt
920[11.6 Ma
934[10.8 Ma

RR TEL
195656
859[12.6 Ht
876[12.6 Ht
883[12.6 Ht

Z CYG
195849
890 11.4 L
893 11.5 Ch
905 12.5 L
910 13.0 Pt
916 12.7 B
921 12.2 Mb

S TEL
195855
859 12.8 Ht
876 12.6 Ht
883 12.8 Ht

SY AQL
200212
861[12.5 Be
868[12.7 Gt
876[12.7 An
894 12.5 L
896 12.3 An
896 12.2 Gt
909 11.1 B
909 10.1 L
910 10.9 Pt

BU CYG
200250
909[12.6 Lj
914[12.7 Lj

S CYG
200357
894[13.3 Ch
910 14.3 L
921[11.5 Mb

R CAP
200514
894 11.0 L
909 10.8 B
910 11.2 Pt
910 11.0 Ch
912 10.8 L

S AQL
200715a
861 9.9 Be
861 9.7 An
872 10.4 An
872 10.4 Gt
872 10.3 Be
880 10.7 Be
882 10.9 Gt
882 11.2 An
896 11.3 An
896 11.3 Gt
910 11.6 Pt
911 11.8 Ch

RW AQL
200715b
910 9.3 Pt

RU AQL
200812
909 12.1 L
909 12.2 B

Z AQL
200906
859 10.5 An
872 9.5 An
872 9.9 Gt
882 9.1 Gt
882 9.0 An
896 9.1 An
896 9.6 Gt
909 11.8 B
910 11.9 Pt

R SGE
200916
858 8.6 An
872 9.2 Gt
882 10.1 Gt
882 10.1 An
896 8.6 Gt
896 8.6 An

RS CYG
200938
893 7.2 Ch
896 7.5 L
908 7.0 Al
908 7.2 Ch
909 7.4 L
910 7.2 Jo
910 7.4 Pt
921 7.2 Jo
924 7.5 Gb
926 7.3 Jo

R DEL
201008
861 10.6 Be
861 10.6 An
872 11.2 An
872 10.9 Gt
872 10.9 Be
882 11.3 Gt
882 11.2 An
889 11.2 Ah
895 11.4 L
896 11.7 An
896 11.7 Gt
908 12.0 B
910 12.3 L
910 12.7 Pt
921 12.0 Mb

RT CAP
201121
910 7.0 Pt

SX CYG
201130
896[13.1 L
916 13.8 B

WX CYG
201437b
896 12.2 L
909 12.4 L
910 12.2 Pt
916 12.9 B

U CYG
201647
889 7.6 Ah
889 7.9 Fd
890 7.7 Ah
899 7.6 Fd
905 7.9 Wd
906 8.0 Ah
907 7.3 Ch
908 7.5 Al
909 7.7 Ah
910 7.8 Jo
910 7.5 Pt
911 7.9 Fd
911 8.2 Sf
912 7.9 Ah
913 7.6 Jo
913 7.6 Md
914 8.0 Ah
915 8.1 Ah
919 7.4 Md
920 7.9 Fd
921 8.4 Sf
921 7.8 Wd
923 8.3 Fd
923 7.6 Md
924 8.4 Fd
924 7.8 Gb
925 8.3 Fd
926 7.8 Al
926 7.8 Jo
931 8.2 Wd
931 8.3 Fd
935 7.6 Md

RW CYG
202539
861 8.8 An
861 8.7 Be
872 8.9 Gt
872 9.0 An
882 9.1 An
882 9.1 Gt
900 8.9 Gt
900 9.0 An

Z DEL
202817
890 8.9 Ma
896 8.7 L
905 9.4 Ch
908 9.4 B
910 9.2 Pt
910 8.6 L

Variable Star Observations Received During November, 1929.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

ST Cyg
202954
894 12.3 Ch
896 12.8 L
910 12.6 L
910 14.2 Pt

V Vul
203226
910 8.8 Pt

Y Del
203611
896 13.3 L
908[12.5 B
910 14.0 L

S Del
203816
889 9.0 Lj
894 9.0 Lj
898 8.9 Lj
900 8.9 Lj
905 8.9 Lj
908 8.7 B
909 9.0 Lj
910 8.7 Pt
914 9.0 Lj
921 8.6 Bx
921 8.6 Mb

V Cyg
203847
879 8.6 Ma
890 8.8 L
891 9.2 Ma
907 9.8 Ch
909 9.5 L
910 9.5 Pt
911 9.0 Ma
920 9.5 Ma
921 10.2 Sf

Y Aqr
203005
882 11.7 Gt
882 11.6 An
895 10.0 Ch
896 10.3 Gt
896 10.2 An
896 10.3 Be
910 9.8 Pt
917 9.8 B

T Del
204016
861[13.3 Be
868[12.5 Gt
872[13.3 An
882[13.3 An
896[13.3 An
910 14.5 L

V Aqr
204102
894 7.8 L
910 8.0 Pt
912 8.0 L
912 8.5 Md
917 8.3 B
918 8.7 Md
923 8.7 Md
936 8.7 Md

W Aqr
204104
894 12.3 L
912 12.5 L
917 13.4 B

U Cap
204215
909 13.4 B
912 12.4 L

V Del
204318
892[13.1 Ma
906[13.9 Br
910[13.9 B
912[13.1 Ch
922[12.4 Ma

T Aqr
204405
872 11.3 Be
872 11.3 Gt
872 11.3 An
882 12.4 An
882 12.4 Gt
895[12.3 Ch
896[12.7 An
911[12.0 Sw
917 13.7 B

RZ Cyg
204846
910 12.4 Pt

S Ind
204954
859 11.1 Ht
876 11.7 Ht
883 11.8 Ht

X Del
205017
894 13.6 L
910 13.6 L

R Vul
205923a
894 9.0 Ch
909 8.1 Ah
910 7.8 Pt
912 7.7 Ah
914 7.8 Ah
915 7.9 Ah
937 8.8 Md

RS Cap
210116
873 8.6 Gt
873 8.6 An

RS Cap
210116
884 8.6 An
884 8.6 Gt
899 8.6 Gt
899 8.6 An

TW Cyg
210129
889 12.5 L
894 12.3 Ch
910 13.2 L

X Cep
210382
906[13.6 Br

RS Aqr
210504
894 11.1 L
910 12.5 Pt
912 12.0 L
917 12.8 B

Z Cap
210516
909 13.0 B
910 12.2 Pt
922[12.2 Ma

T Cep
210868
889 7.6 Fd
889 6.9 Ah
901 6.5 Ah
905 6.4 Ch
906 6.2 Ah
909 6.2 Ah
910 6.6 Jo
910 6.3 Fd
911 6.4 Fd
911 6.5 Sw
912 6.2 Fd
912 6.0 Ah
913 6.5 Jo
914 6.1 Ah
915 6.1 Ah
920 6.6 Fd
921 6.4 Wd
921 6.4 Jo
921 6.3 Pt
923 6.0 Fd
924 6.0 Fd
925 5.8 Fd
931 5.8 Fd

RR Aqr
210903
859 9.8 An
873 9.9 An
873 9.8 Gt

RR Aqr
210903
884 10.2 An
894 10.3 L
896 10.4 Be
896 10.5 An
896 10.4 Gt
910 11.4 L
917 12.0 B
921 12.3 Pt

Y Pav
211570
859 6.5 Ht
869 5.8 Ht
876 5.8 Ht
883 5.6 Ht

X Peg
211614
859 14.2 An
893 13.0 Ma
894 12.8 L
896 13.6 Gt
896 13.6 Be
896 13.5 An
907 11.5 Br
912 10.2 L
921 11.0 Pt
922 10.7 Ma

T Cap
211615
894 13.5 L
912 14.1 L

S Mic
212030
862 9.3 En

Y Cap
212814
858[13.1 An
912 14.5 L
917[13.6 B

W Cyg
213244
857 6.0 An
862 6.0 Gt
867 5.7 Gt
871 5.4 Gt
880 5.4 Gt
886 5.9 L
888 5.4 Gt
893 6.0 L
896 5.4 Gt
902 5.5 Gt
902 6.4 An
906 5.9 L
910 6.1 Tf
912 6.0 L

S Cep
213678
906 11.4 Br
914 11.2 Ch

S Cep
213678
921 10.7 Pt
921 10.9 Mb
921 11.6 Bx
937 11.9 Md

RU Cyg
213753
909 9.6 Ah
921 8.8 Pt

RV Cyg
213937
921 6.4 Pt

RR Peg
214024
859 13.5 An
873[11.6 Gt
879 13.2 An
907[13.4 Br

R Gru
214247
862[12.9 En
876[12.9 Ht
883[12.9 Ht

V Peg
215605
859 12.6 An
879 13.1 An
894 13.8 L
914 14.3 L

U Aqr
215717
894 12.5 L
912 12.6 L
917 12.5 B
921 12.0 Pt

RT Peg
215934
886 11.2 L
914 11.4 L
921 11.7 Pt

RY Peg
220133a
921 12.3 Pt

RZ Peg
220133b
889 11.7 L
914 11.0 L
921 11.3 Pt

T Peg
220412
894[13.7 L

Y Peg
220613
894 12.7 L
914 14.5 L

RS Peg
214024
914 10.0 L
921 10.2 Pt
922 10.1 Ma

RS Peg
220714
921 13.0 Pt

T Gru
221938
862 9.6 En

S Gru
221948
859 11.7 Ht
862 11.8 En
876 12.7 Ht
883 12.5 Ht

RV Peg
222129
894[13.7 L
914[13.3 Ch

S Lac
222439
868 9.4 Gt
868 9.6 An
879 9.5 An
880 9.5 Gt
880 9.1 Be
886 9.6 L
889 9.8 Gt
889 9.7 An
889 9.7 Be
911 11.0 L
921 11.5 Pt
926 11.8 Al

R Ind
222867
859 13.5 Ht
876[13.5 Ht
883[13.5 Ht

T Tuc
223462
859 10.4 Ht
869 10.3 Ht
876 9.6 Ht
883 9.2 Ht

R Lac
223841
886 11.0 L
910 9.1 Tf
911 9.4 L
921 9.3 Pt

RW Peg
225914
879 9.6 Ma
888 8.9 L
890 9.6 Ma
901 9.6 Ma
907 9.7 Br
907 9.8 Ch
911 9.3 Ma
914 10.0 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R PEG			**W PEG**			**Z AND**			**R AQR**			**RR CAS**			**Z PEG**		
230110			231425			232848			*233815*			235053			235525		
878	9.7	Kl	889	9.8	An	896	10.2	An	872	8.8	An	859	11.5	An	913	12.8	Ch
882	9.9	Kl	889	9.8	Be	896	10.2	Be	876	8.8	Ht	872	11.5	An	914	12.9	Lj
887	9.9	Kl	895	10.2	Kl	903	10.3	Bx	879	8.8	Ma	872	11.5	Gt	914	13.1	L
895	10.0	Kl	908	9.9	Al	912	10.5	Cr	882	8.8	Gt	882	11.7	Gt	918	13.0	Br
907	10.9	Ch	910	10.8	Ch	912	10.4	Mb	882	8.7	An	882	11.8	An	921	12.6	Pt
907	10.7	Br	914	10.0	L	921	9.8	Pt	883	8.7	Ht	899	12.3	Gt	922	12.6	Lg
937	12.4	Md	926	11.1	Al	922	10.0	Lg	885	8.5	Ch	899	12.3	An	**W CET**		
V CAS			**S PEG**			924	11.8	Mb	891	8.7	Ma	908	12.8	B	*235715*		
230759			231508			924	10.2	Mb	894	8.7	L	911	13.1	Bn	876	8.0	An
908	11.0	B	888	12.1	L	**ST AND**			896	8.7	Be	917	13.3	Bn	**Y CAS**		
910	11.5	Ch	914	13.0	L	233335			896	8.6	An	**R TUC**			235855		
918	11.7	Br	914	13.0	Ch	885	10.8	Ch	896	8.3	Gt	235265			888	12.9	L
921	11.7	Pt	918	13.0	Br	889	10.2	Lj	905	8.8	L	859	13.0	Ht	908	12.2	B
934	12.2	Md	921	13.5	Pt	894	10.4	Lj	910	8.9	Tf	883	13.0	Ht	911	12.6	L
W PEG			**RY CEP**			898	10.7	Lj	912	8.6	Ma	**R CAS**			913	12.2	Ch
231425			231878			905	10.0	Al	914	8.9	Tf	235350			922	11.9	Lg
862	9.2	Gt	910	11.0	Ch	907	10.9	Lj	921	8.7	Pt	908	9.6	B	924	11.8	Mb
868	9.1	Gt	**V PHE**			913	10.8	B	922	8.7	Ma	914	9.5	Ch	**SV AND**		
868	9.2	An	*232746*			914	10.9	Lj	**Z CAS**			924	8.2	Mb	235939		
876	9.5	An	859	11.8	Ht	921	10.5	Pt	233956			**Z PEG**			859	11.7	An
876	9.1	Gt	883	10.1	Ht	926	10.5	Al	890	13.9	L	*235525*			877	12.4	An
878	9.4	Kl	**Z AND**			**R AQR**			908	13.3	B	888	12.0	L	893	12.4	An
882	9.4	Kl	232848			*233815*			911	13.3	L	889	12.3	Lj	896	12.4	Gt
887	10.0	Kl	859	10.2	An	859	8.8	Ht	914	13.3	Ch	894	12.4	Lj	896	12.4	Be
888	9.2	L	877	10.0	An	869	8.7	Ht	918	12.8	Br	909	12.9	Lj	910	12.5	B
889	9.8	Gt	896	10.3	Gt	872	8.7	Gt							918	12.3	Be

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX ANDROMEDAE—							060547 SS AURIGAE—						
	5892.4	11.6	Gt	5910.7	11.5	Pt		5900.4	11.8	Gt	5910.5	14.7	L
	5896.4	11.6	An	5911.7	11.4	Pt		5900.4	11.7	An	5911.7	12.4	Pt
	5896.4	11.6	Be	5913.6	11.2	Br		5901.4	11.0	Gt	5912.2	13.3	Ch
	5897.3	10.8	An	5918.7	13.3	Br		5901.4	10.9	An	5914.6	14.4	L
	5899.3	11.2	Be	5918.7	13.2	Pt		5901.6	11.0	L	5915.6	14.7	L
	5899.3	11.1	An	5921.7	12.7	Pt		5902.3	10.9	L	5920.9	12.6	Pt
	5899.3	10.7	Gt	5922.7	12.4	Pt		5902.4	10.8	An	5921.7	12.6	Pt
	5900.4	11.7	Gt	5923.6	11.6	Br		5902.6	10.9	L	5922.7	13.9	Lg
	5900.4	11.4	An	5923.9	11.4	Pt		5903.4	11.0	L	5923.9	12.6	Pt
	5901.3	11.7	An	5924.7	11.3	Pt		5903.6	11.3	L	5925.9	12.6	Pt
	5901.3	11.7	Gt	5925.7	11.5	Pt		5906.6	12.8	L	5926.8	12.4	Pt
	5902.3	11.7	Gt	5926.6	11.4	Br		5908.6	13.9	L			
	5906.6	13.5	Br	5826.8	11.2	Pt	074922 U GEMINORUM—						
	5907.7	13.5	Br					5886.6	13.9	L	5902.6	13.9	L
010884 RU CEPHEI—								5887.6	13.9	L	5903.6	13.7	L
	5886.6	8.8	L	5914.6	8.8	L		5888.7	14.1	L	5905.6	13.7	L
	5899.6	8.6	L					5889.7	14.1	L	5908.6	13.3	L
060547 SS AURIGAE—								5890.6	14.0	L	5910.5	13.7	L
	5882.4	13.3	An	5894.6	14.5	L		5893.6	14.0	L	5911.6	14.0	L
	5884.5	13.9	An	5894.6	14.2	L		5894.6	14.1	L	5913.6	14.0	L
	5885.4	13.3	Gt	5895.6	14.5	L		5895.6	13.9	L	5914.6	14.1	L
	5886.6	14.8	L	5896.6	14.8	L		5896.7	13.7	L	5915.6	14.0	L
	5887.6	14.8	L	5897.7	12.4	Pt		5897.7	12.4	Pt	5920.9	12.4	Pt
	5888.7	14.5	L	5898.6	13.7	L		5898.6	14.0	L	5923.9	12.4	Pt
	5889.6	14.8	L	5898.7	13.6	L		5899.7	14.1	L	5925.9	13.3	Pt
	5890.6	14.5	L	5899.6	12.1	L		5900.7	14.1	L	5926.8	12.4	Pt
	5893.6	14.7	L	5900.4	11.6	L		5901.6	14.0	L			

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

Star	J.D.	Est.	Obs
081473 Z CAMELOPARDALIS—			
	5857.3	12.3	An
	5857.3	11.9	Be
	5858.3	12.4	Be
	5858.3	12.7	An
	5870.5	10.8	An
	5872.4	10.6	An
	5872.4	10.8	Gt
	5873.4	10.9	Gt
	5873.4	10.5	An
	5876.3	11.1	An
	5876.3	11.3	Gt
	5879.3	11.4	Gt
	5880.4	11.6	Gt
	5880.4	11.6	An
	5882.4	11.5	An
	5882.4	11.7	Gt
	5883.4	11.8	Gt
	5884.5	11.3	An
	5885.4	11.2	An
	5885.4	11.2	Gt
	5886.6	11.8	L
	5887.3	11.6	L
	5887.6	11.9	L
	5888 3	11.6	L
	5889.3	11.6	L
	5889.4	11.6	Gt
	5889.4	11.6	An
	5889.4	11.5	Be
	5889.6	11.7	L
	5890.6	11.8	L
	5893.6	11.8	L
	5894.4	11.7	L
	5894.6	11.8	L
	5895.4	11.7	L
	5896.3	11.8	L
	5896.4	11.5	Gt
	5896.4	11.5	An
	5896.6	11.8	L
	5897.3	11.7	L
	5897.3	11.6	An
	5898.3	11.8	L
	5898.6	11.7	L
	5899.3	11.7	L
	5899.3	11.5	Gt
	5899.3	11.6	An
	5899.3	11.6	Be
	5900.3	11.7	L
	5900.4	11.5	An
	5900.4	11.4	Gt
	5901.3	11.5	Gt
	5901.3	11.4	An
	5901.7	11.9	L
	5902.4	11.8	L
	5902.4	11.5	Gt
	5902.4	11.3	An
	5903 3	11.6	L
	5903.3	11.7	L
	5905.2	12.1	L
	5906.6	12.2	L
	5908.4	12.6	L
	5908.7	12.4	L
	5909.3	12.7	L
	5910.3	12.4	L
	5911.6	12.5	L
	5912.4	12.8	L
	5913.6	12.5	L
	5914.4	12.9	L
	5915.6	12.7	L
094512 X LEONIS—			
	5886.7	12.8	L
	5887.6	14.2	L
	5888.7	14.2	L
	5889.7	12.5	L
	5890.7	13.8	L
	5893.6	13.0	L
	5894.6	14.2	L
	5895.6	14.3	L
	5898.6	13.3	L
	5899.7	13.8	L
	5900.7	13.8	L
	5901.7	14.7	L
	5902.7	13.8	L
	5903.6	13.8	L
	5908.7	14.2	L
	5911.6	12.8	L
	5914.7	14.7	L
	5915.6	12.1	L
202946 SZ CYGNI—			
	5897.7	9.5	Pt
	5898 8	9.1	Pt
	5899.7	9.0	Pt
	5900.7	8.9	Pt
	5901.7	8.8	Pt
	5902.7	8.9	Pt
	5904.7	9.0	Pt
	5910.7	9.6	Pt
	5911.7	9.6	Pt
	5912.7	9 6	Pt
	5918.7	8.9	Pt
	5921.7	9.2	Pt
	5922.7	9.6	Pt
	5924.7	9.6	Pt
	5925.7	9.6	Pt
	5926.8	9.5	Pt
	5927.7	9.4	Pt
213843 SS CYGNI—			
	5857 3	11.2	An
	5857.3	11.6	Be
	5858.3	11.5	Be
	5858.3	11.2	An
	5859.3	11.5	An
	5861.4	11.9	An
	5862.4	11.2	Gt
	5867.3	11.6	Gt
213843 SS CYGNI—			
	5867.3	11.1	An
	5868.3	11.2	An
	5868.4	11.6	Gt
	5869.3	11.2	Gt
	5869.3	11.3	An
	5872.3	8.1	An
	5872.3	8.3	Be
	5872.3	8.2	Gt
	5872 5	8.2	Gt
	5872.5	8.4	An
	5873.3	8.2	Gt
	5873.4	8.2	Gt
	5873.4	8.1	An
	5874.3	8.1	An
	5875.7	8.4	Ma
	5876.3	8.4	Gt
	5876.3	8 4	An
	5876.5	8.4	An
	5876.7	8.6	Ma
	5877.3	8.4	An
	5878.3	8.2	An
	5878.8	8.6	Ma
	5879.3	8.4	An
	5879.4	8.4	Gt
	5879 8	8.6	Ma
	5880.3	8.4	An
	5880.3	8.4	Gt
	5880.3	8.5	Be
	5881.3	8.4	An
	5881.3	8.5	Gt
	5882.3	8.5	An
	5882.3	8.6	Gt
	5882.4	8 9	Gt
	5882.4	8.7	An
	5883.2	9.0	Be
	5883.3	9.2	An
	5883.4	9.3	Gt
	5883.8	9.3	Ma
	5884.3	9.6	An
	5884.3	9.6	Gt
	5884 5	9.7	An
	5885.0	9.8	Ch
	5885.4	10.1	Be
	5885.4	10.1	An
	5885.4	10.1	Gt
	5886.3	10.3	Lj
	5886.6	10.1	L
	5887.2	10.2	L
	5888 2	10.4	L
	5888.3	11.3	Gt
	5888.6	10.7	L
	5888.7	10.4	Ma
	5889.2	11.3	Gt
	5889.2	10.7	L
	5889.3	10.6	Pt
	5889.3	10.7	Lj
	5889.4	11.2	An
	5889.4	11.2	Be
	5889 7	11.8	Fd
	5890.3	11.0	L
	5890.3	11.2	Lj
	5890.5	10.8	Pt
	5890.6	11.1	L
	5890.7	10.5	Ma
	5891.8	10.7	Ma
	5892.7	10.7	Ma
	5893.3	11.4	L
	5893.7	11.1	Ma
	5894.2	11.5	Lj
	5894.3	11.4	L
	5896.2	11.4	L
	5896.4	11.6	Gt
	5896.4	11.9	An
	5896.6	11.3	L
	5897.2	11.6	Ch
	5897.2	11.7	An
	5897.7	11.7	Pt
	5898.2	11.1	Lj
	5898.3	11.5	L
	5898.8	11.6	Pt
	5899.2	11.5	L
	5899.3	11.4	Gt
	5899.3	11.5	An
	5899.3	11.4	Be
	5899.7	11.7	Fd
	5899.7	11.7	Pt
	5900.2	11.2	An
	5900.3	11.4	L
	5900.4	11.4	Gt
	5900.7	11.6	Pt
	5901.2	11.4	L
	5901.4	11.1	Gt
	5901.7	11.4	Ma
	5901.7	11.6	Pt
	5902.3	11.2	Gt
	5902.3	11.4	L
	5902.4	11.5	An
	5902.7	11.6	Pt
	5903.4	11.4	L
	5904.2	11.4	L
	5904.7	11.7	Pt
	5905.3	11.6	Lj
	5906.2	11.2	L
	5906.6	11.6	Br
	5907.2	11.5	Lj
	5907.2	11.6	Ch
	5907.6	11.5	Br
	5908.4	11.5	L
	5908.6	11.3	Al
	5908.7	11.8	Lg
	5909.3	11.8	Pt
	5909.4	11.7	Lj
	5909.4	11.4	L
	5909.6	11.8	Mg
	5910.1	11.6	Ch
	5910.5	11.4	L
	5910.6	11.5	B
	5910.6	11.6	Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1929.

Star	J.D.	Est.Obs	J.D.	Est.Obs.	Star	J.D.	Est.Obs.	J.D.	Est.Obs.
213843 SS CYGNI—					213843 SS CYGNI—				
	5910.7	11.6 Pt	5912.7	11.7 Pt		5918.7	11.7 Pt	5923.6	8.6 Fd
	5910.7	11.7 Ma	5912.7	10.6 Bc		5919.7	11.1 Md	5923.6	8.7 Br
	5910.7	11.9 Fd	5913.2	11.4 Ch		5920.7	11.1 Ma	5923.6	8.5 Md
	5911.6	11.3 L	5913.6	11.7 Br		5920.7	11.6 Fd	5924.7	9.2 Pt
	5911.7	11.7 Pt	5913.6	11.8 Jo		5921.7	9.1 Bx	5924.7	9.1 Fd
	5911.7	11.7 Sw	5914.2	11.8 Lj		5921.7	9.0 Mb	5925.7	9.1 Ma
	5911.7	11.9 Fd	5914.3	11.4 L		5921.7	10.4 Pt	5925.7	9.0 Pt
	5911.8	11.7 Ma	5914.4	11.5 Pt		5921.8	9.2 Ma	5925.8	8.7 Fd
	5912.3	11.9 Pt	5915.3	11.5 Lj		5922.5	8.6 Ma	5926.6	9.2 Br
	5912.4	11.7 L	5915.5	11.5 Pt		5922.6	8.8 Br	5926.6	9.5 Al
	5912.7	11.7 Ma	5915.6	11.5 L		5922.7	8.8 Lg	5926.8	9.0 Pt
	5912.7	11.8 Fd	5916.4	11.9 L		5922.7	8.6 Md	5927.7	9.5 Pt
	5912.7	11.5 Md	5918.7	11.6 Br		5922.7	9.0 Pt	5931.8	11.5 Fd
								5935.6	11.5 Md

MONTHLY SUMMARY FOR NOVEMBER, 1929.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	29	96	Houghton	Ht	57	162
Allen, P. R.	Al	16	21	Jones	Jo	28	82
Ancarani	An	65	256	Kohl	Kl	8	34
Barnes	Bx	8	8	Lacchini	L	175	593
Benini	Be	34	92	Leiner	Lj	15	82
Boutell	BL	8	45	Logan	Lg	12	12
Bouton	B	55	55	Marsh	Ma	26	88
Brocchi	Br	33	45	McBride	Mb	13	19
Brown	Bn	3	5	Millard	Md	17	38
Buckstaff	Bc	4	14	Monnig	Mg	3	3
Carl	Cr	3	3	Peltier	Pt	170	298
Chandra	Ch	125	142	Smith, F. W.	Sf	8	14
Ensor	En	53	53	Swanson	Sw	8	8
Ferris	Fe	1	2	Taffara	Tf	10	17
Ford	Fd	17	88	Webb	Wd	8	15
Gaebler	Gb	5	7				
Gallanti	Gt	54	198	Totals		32	374	2595

We regret to have to record the serious illness of our Mr. Yalden, chairman of our Occultation Committee. We hope for his speedy recovery to normal good health.

SS Cygni and SS Aurigae have been in the limelight during the interval covered by these observations, the former being at maximum on two occasions, and the latter on one occasion. U Geminorum has been faint for some months past, but it should be at maximum again ere many days.

December 11, 1929. LEON CAMPBELL, Recording Secretary.

COMET NOTES.

By G. VAN BIESBROECK.

COMET 1929 *d* (WILK). The fourth comet of the year 1929 was announced telegraphically on December 21:

Comet Wilk. Magnitude 7
Dec. 20.7396 U.T. $18^h 6^m 0^s$, $+36^\circ 18'$ (1855)
Motion South East East

The discoverer has already a previous comet, namely 1925 *k*, to his credit. The new object was probably also found at Cracow (Poland) where Wilk found

the 1925 object.

The announcement was received at Williams Bay on the first clear day after two weeks of cloudiness. After sunset the object was located without difficulty, and from a short exposure with the 24-inch reflector an accurate position was

FIGURE 1.
COMET WILK, DECEMBER 22.0015 U.T., PHOTOGRAPHED BY G. VAN BIESBROECK.

secured. The object moves nearly 2.5 degrees per day from which it may be inferred that its distance from the earth is not large. Figure 1 shows the appearance of the comet on a 20-minutes exposure by the writer; the diffuse coma has a diameter of 5′ and the central condensation does not show a sharp nucleus. There is, however, a narrow slender tail pointing almost exactly opposite to the direction of the sun. It can be seen over one-third of a degree on the original plate from which Figure 1 is a 6 times enlargement.

The following accurate observations have been telegraphed up to the time of writing:

1929	α (1929.0) h m s	δ (1929.0) ° ′ ″	
Dec. 21.7306 U.T.	18 20 15.7	+35 23 30	Wolf-Heidelberg
22.0015	23 26.16	35 6 55	Van Biesbroeck-Williams Bay
23.1089	36 14.4	33 55 20	Jeffers-Mt. Hamilton

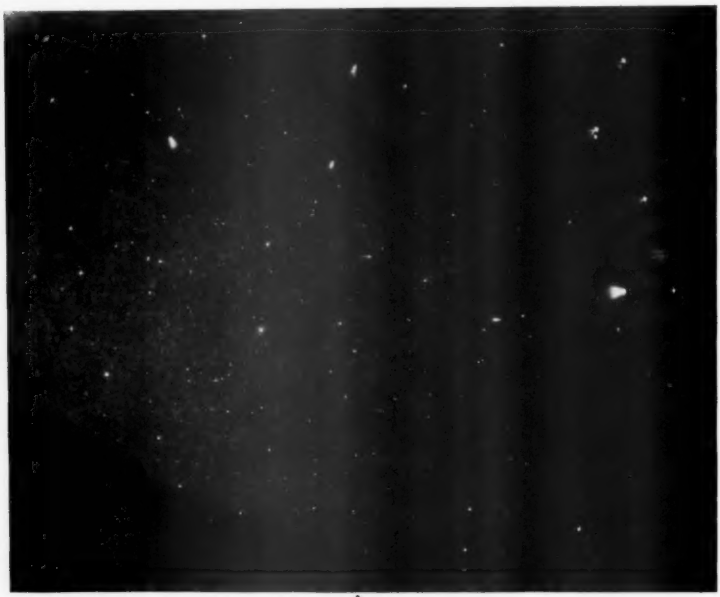
They show that the comet, which was nearly in conjunction with the sun at discovery, is now moving in a southeasterly direction across the constellation of Lyra, so that it will remain visible for some time in the evening sky. It is too soon to foretell whether the object will become brighter than the inconspicuous nebulosity that it showed at discovery.

As was anticipated in these notes last month (p. 607) no further impression could be found of COMET 1929 *c* (FORBES) on plates taken here November 29-30, although they showed stars as faint as 17ᴹ. Thus the comet has been followed for scarcely four months.

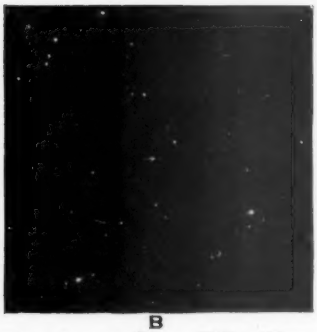
Measurements on plates secured November 22 by the writer show that on that date the correction of the ephemeris for 1927 *d* (STEARNS) given on p. 347 (Vol. **37**) was —11ˢ and 0″3. The image of the comet appeared as a small round nebulosity about 8″ in diameter, which was easily measurable. It would not be

surprising now if photographic records could be continued until next March, which would be three years after discovery.

The value of photographic plates as a record of the past has been demonstrated once more by a recent occurrence. From a letter to the writer by F.



A



B

C

PHOTOGRAPHS OF COMET 1928 *c* (FORBES) BY F. QUÉNISSET, BEFORE ITS DISCOVERY.

Quénisset, astronomer at the Flammarion Observatory at Juvisy near Paris, it appears that he has recorded COMET 1928 *c* (FORBES) last year on October 25, four weeks before it was discovered at Cape Town. Quénisset was using a

very fast lens of ratio F/1.9 in an effort to get a good picture of the Zodiacal light in the morning sky. He was located then not at Juvisy but at a mountain station 2000 meters high near Saint Moritz in the upper Engadine, Switzerland. How well he has succeeded in recording the Zodiacal Light can be seen from Figure A. The brightest star to the right of the center is Regulus and the constellation of Leo occupies the upper half of the picture which is enlarged slightly from the original. The intention was primarily to photograph the Zodiacal Light but at the same time Quénisset had in mind the search for comets. Last year he had examined his plates from this point of view hurriedly because the impression of the Zodiacal Light had mostly retained his attention. But while recently reading these "comet notes," he noticed that the position of Comet Forbes on October 25, 1928, was in the region covered by his plates. The examination of these revealed at once the comet near the star BD + 12°2284 and two plates taken at an interval of half an hour confirmed the motion. Figures B and C show a 2.6 times enlargement of these plates. The arrows point to the image of the comet. The exposure-times were respectively 16 and 14 minutes. The magnitude was estimated as $7^{M}.5$ by Quénisset, who also determined the position graphically as follows:

$$\left.\begin{array}{lll} 1928\ \text{Oct.}25\ \text{at}\ 3^{h}\ 42^{m}\ \text{U.T.} & 10^{h}\ 55^{m}\ 24^{s} & +\ 11^{\circ}\ 40' \\ \text{at}\ 4\ 12 & 55\ 34 & 37 \end{array}\right\}\ (1900.0)$$

The scale of these plates is very small since the focal length is only 135 mm but on account of the unusual value of this early record in reducing the uncertainty of the period the writer has measured as carefully as possible the first enlargement sent by Quénisset, with the result:

$$1928\ \text{Oct.}25.154\ \text{U.T.}\quad 10^{h}\ 56^{m}\ 54^{s}.5 + 11^{\circ}\ 32'\ 3''\ (1928.0)$$

The position ought to be reliable within 5″. A better place yet could be obtained by direct measurement of the original plate.

Williams Bay, Wisconsin, December 23, 1929.

GENERAL NOTES.

Editor's Note.—From time to time our attention is called to the fact that some material which appears in these pages cannot, with much propriety, be called popular astronomy. We admit it. It is, however, our constant endeavor that each issue shall contain some material which will satisfy those who are interested in astronomy as amateurs only and not as professionals. We are fortunate in having a series of papers of this kind, the first one appearing in this issue. Twelve or more amateurs, who have constructed their own observatories or telescopes or both, have agreed to furnish papers descriptive of their equipment and its history. The paper contributed by William Tyler Olcott, the Secretary of the American Association of Variable Star Observers, will be found beginning on page two. Others will follow from month to month. We commend them to the readers of POPULAR ASTRONOMY.

Godfrey Club. — An association of amateur astronomers, known as the Godfrey Club and having its origin in some Boy Scout activities of Watertown, Wisconsin, was recently organized with its headquarters at the Watertown Public Library. A threefold program of activities, consisting of teaching constellations, making small telescopes, and observing variable stars, was begun. An illustrated

lecture by Mr. R. N. Buckstaff, of Oshkosh, Wisconsin, sponsored by the club was well attended. Correspondence with other clubs is invited. Address Ray Dornfeld, Sec. Godfrey Club, Public Library, Watertown, Wisconsin.

Eclipse Note.—I have recently received from the British Colonial Office a statement of the results of a recent volcanic outbreak in the island of Niuafoou, which lies in the belt of totality of the eclipse of 1930 October 21. One-third of the cultivated area of the island has been destroyed, also the village of Futu, which has the only good anchorage for small craft on the island. Earlier official information as to the conditions holding in the island have had to be modified considerably. In the event of any expedition being organized to observe the eclipse I shall be glad to pass on the information which I have received as to the landing of heavy cases, supply of fresh provisions, labor, etc.

F. J. M. Stratton.

Cambridge, England, November 27, 1929.

Astronomy in the Canal Zone, Panama.—A large part of the front page of the *Star and Herald* for November 29, a daily paper published at Panama, is devoted to a picture of an equatorially mounted telescope and an account of the securing of a telescope for the Canal Zone. A five-inch telescope is to be loaned to a group of interested people in Panama by the Department of the Navy. This arrangement has been brought about through the efforts of Mr. James A. Hess, who has plans for organizing an astronomical society which shall have charge of the telescope while it is in the Canal Zone.

Observatory Bulletin from Wellington, New Zealand.—A copy of the first bulletin, recently issued by the observer, Mr. A. G. C. Crust, at the Dominion Observatory, Kelburn, Wellington, New Zealand, has been received. It contains a summary of the observations for the year ending with October 31, 1929, which consisted mainly of observing some two hundred stars for purposes of color determinations. The bulletin denotes considerable activity at this observatory during the past year.

New Observatory of the University of London.—There are already observatories at the Imperial College of Science and Technology, University College, and the Drapers' Company Transit House, but there was felt to be need for further opportunities in the University of London for research work. Professor L. N. G. Filon and Mr. C. C. L. Gregory were fortunate in receiving an offer from Mr. J. G. Wilson of the 24-inch reflecting telescope with which his father, Mr. W. E. Wilson, carried out many useful researches at Darramona, Ireland; the only condition attached to the gift was that the University should erect a suitable building for it.

The Hendon Urban District Council offered a site opposite Mill Hill Park, which has been leased to the University for 999 years at a nominal rental. The Senate of the University voted £5000 for the building, and four London colleges with the London School of Economics voted annual subsidies towards its maintenance. The building being near a main road, vibration of the soil gave some trouble, but this was cured by filling the space around the pier with coke breeze. A new guiding telescope with a 6-inch objective by Cooke (focal length, 11½

feet) was attached to the equatorial; the guiding eyepiece was mounted on a micrometer and position circle, to enable the telescope to follow moving objects. An 18-foot dome was constructed by Messrs. Cooke, Troughton and Simms, Ltd.; this had electrical driving, which can be controlled either from the floor or the eye-end. The Observatory has also a 10-foot Rowland grating spectrograph, fed by a cœlostat by Cooke, which can by adjusted either for solar or stellar work.

Professor Filon is the Director of the new Observatory, and Mr. C. C. L. Gregory has the title of Wilson Observer. Students in the Faculty of Science in all the colleges of the University will be able to study at the Observatory, and the facilities will be given for the investigation of new observational methods.

The general public will be permitted to view the Observatory on two afternoons in each month, except from July to September; ratepayers of Hendon will occasionally be admitted at night (two evenings per month from October to March) on making written application to the Director.

The Observatory was opened and the Wilson telescope unveiled by Sir Frank Dyson, the Astronomer Royal, on the afternoon of Tuesday, October 8. (From *Nature* for October 12, 1929.)

Zodiacal Light Notes.

It is a pleasure to announce that an Aurora and Zodiacal Light Section has been started by the New Zealand Astronomical Society. Under date of November 18, Mr. Ivan L. Thomsen, Dominion Observatory, Kelburn, Wellington, N. Z., writes that several inquiries have been received concerning the new Section which he hopes will be a valuable adjunct to the Society's work. He also enclosed reports of five observations, one by himself and four by Mr. A. G. C. Crust, accompanied by excellent diagrams.

New Zealand Evening Zodiacal Light Observations: 1929 July 29, 7:00 to 7:15 G.M.T. Observer, A. G. C. Crust. Light very bright extending along ecliptic from Leo. Light very conspicuous to η Virginis, easily traceable to Spica. Edges well defined. Breadth from δ Crateris to β Leonis, 30°.

August 1 at 7:05 G.M.T. Observer, A. G. C. Crust. Appearance and position similar to that of July 29 except that the main body seems to have moved slightly south; δ Leonis outside the edge. North edge noticeably sharper than south.

August 1, 7:00 G.M.T. Observer, I. L. Thomsen. Diagram shows Light extending through Leo almost to Spica. Estimated breadth on horizon about 25°; extension along ecliptic from horizon about 65°. "Lower portion of Light much brighter than the portion near the apex, the extreme limit of which was hard to see."

August 27, 7:00 to 7:15 G.M.T. Observer, A. G. C. Crust. Outer cone extends to α Librae, faintly. Inner cone extends to midway between Spica and α Librae distinctly.

October 29, 9:00 G.M.T. Observer, A. G. C. Crust. Light shown extending from the head of Scorpio to σ Sagittarius, about 30° on the horizon and 55° from horizon to apex. Brightness less than Milky Way. All of these observations were made near Wellington, New Zealand, and all show the main body of the Light south of the ecliptic. In addition to the observation reports Mr. Thomsen enclosed a copy of the *Monthly Astronomical Notes* for September by E. G. Hogg, Esq., which contain a special paragraph on Zodiacal Light observations.

Mr. Ralph Lefever of Strang, Nebraska, reports: "Zodiacal Light observed

December 2 and 3 at 7:00 P.M. as a faint, long, narrow wedge extending from the southwest sky to the meridian. Base about 10° wide. On December 3 also, auroral streamers were seen 15° long and extended upwards from 5° to 10° east of north.

Morning Zodiacal Light: On December 1 at 5:15 A.M. the writer found the sky east of the meridian perfectly clear, the Light strong along the horizon for 25° and extending west to Regulus, a beautiful pillar of light which continued steady until 5:35 when it faded out as dawn came.

Gegenschein: On December 6 at 11:50 P.M., sky clear, the Gegenschein was glimpsed just west of the Milky Way in Taurus. The apparition was extremely faint and on account of Jupiter it was impossible to determine its shape and extent.

The time has come for evening observations and observers are asked to give especial attention (1) to the detection of pulsations or fluctuations, which will need somewhat prolonged observations; and (2) to determine if the south boundary is sharper than the north boundary.

W. E. GLANVILLE.

The Rectory, New Market, Maryland.

BOOK REVIEW.

Handbuch der Astrophysik, Band II. erste hälfte, Grundlagen der Astrophysik. 430 pp. 1929. Julius Springer, Berlin. Price, bound, 69 marks.

This volume of the *Handbuch* is the third which has appeared. In completeness of contents and method it follows its predecessors which have been reviewed in POPULAR ASTRONOMY, Nos. 363 and 367. The material is divided into four sections: Theoretical Photometry, Spectrophotometry, Colorimetry, and Photoelectric Photometry. The authors of the sections are Prof. E. Schoenberg of Breslau, Prof. A. Brill of Neubabelsberg, Prof. K. F. Bottlinger of Neubabelsberg, and Prof. H. Rosenberg of Kiel respectively. In order to give some idea of the way in which the entire material is handled we shall list the subdivisions of the last section, that on Photoelectric Photometry which covers 50 pages. These subdivisions are: Introduction, Historical references, Characteristics of illuminated bodies, Influence of light, Color sensitivity, Theories of the photoeffect, Special case of photoelectric action, Alkali metal photocells, Sources of error of alkali metal photocells, Construction of photocells, Selenium cells, Sources of error in measurements with selenium cells, Measurement of weak electric currents, Elimination of fatigue and recuperation effects, Measurement of resistances, Direct photometric measurements of the heavens, Instruments for microphotometric measurements, Fields of direct sky measurements and fields of usefulness of the electrophotomicrometer. Each section covers the essential portions of its subject. Many diagrams of curves and electrical circuits and cuts of apparatus are included. Many references to original papers are given in footnotes.

One portion of the first section on Theoretical Photometry deserves special mention. This is a series of tables covering 50 pages. It includes practically all tables that anyone engaged in stellar and planetary photometry would have occasion to use. The volume will be of great value to everyone working in celestial photometry as well as to the general reader who wishes information in this field.

E. A. F.